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# **Gunners' Instruction**

**(Fourteenth Edition)**

## **GUN COMPANIES**

**1917-1918**

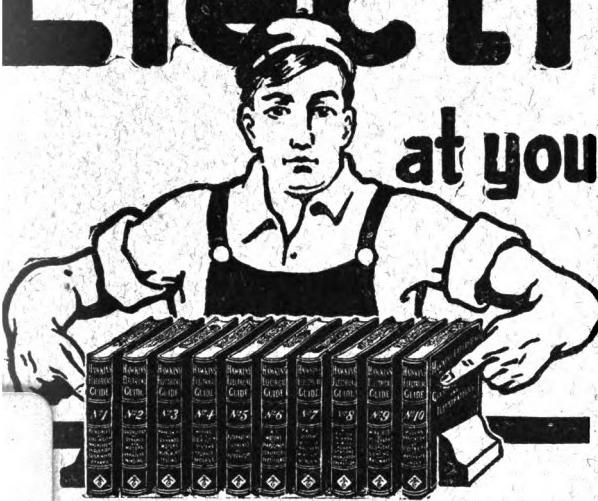
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# Gunners' Instruction

**1917-1918**

**(Gun Companies)**

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As in the past, the JOURNAL will appreciate having brought to its attention suggestions looking to the perfection of the pamphlet.

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## GUN COMPANIES

### SECOND CLASS

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- (a) SERVICE OF THE PIECE. See Supplement.
  - (b) NOMENCLATURE OF THE VARIOUS PARTS OF THE GUN AND CARRIAGE; and,
  - (c) ACTION, ADJUSTMENT AND CARE OF THE VARIOUS PARTS OF GUNS AND CARRIAGES
- 

- Q. To what guns is your company assigned?
- A. Battery-----, -inch guns, model-----
- Q. What kind and model of carriage?
- A. -----carriage, model-----

#### GUNS

Point out or describe location of such of the following parts as apply to the guns of your battery:

Breechblock.	Slide stop.
Breechplate	Contact clip.
Breech recess.	Contact clip housing
Breech reinforce.	Forcing cone.
Centering slope.	Gas-check pad.
Chase.	Gas-check seat.
Compound gear.	Gear segment.
Electric firing circuit:	Grooves.
Firing cable.	Guide rails.
Circuit breaker.	Guide groove.
Exterior split rings.	Hinge pin
Filling-in-disc.	Hoops.
Firing mechanism:	Lands.
Ejector.	Interior split ring.
Guide bar.	Loading tray.
Hinged collar.	Locking slide.
Safety bar.	Lock nut
Safety bar slide.	Main bore.
Safety bar slide housing.	Mushroom head.
Firing leaf.	Muzzle.
Slide.	Obturator spindle.

Obturator spindle nut.	Teat-wrench holes.
Oil holes.	Translating roller.
Operating crank.	Translating stud.
Operating lever.	Tray
Powder chamber.	Tray ball bearing.
Pressure plugs, dummy.	Tray latch.
Rotating crank.	Tray latch catch.
Rotating crank catch (lock).	Tray latch operating stud.
Safety lanyard device.	Tube.
Safety lock.	Vent.
Securing latch.	Vent bushing.
Securing latch catch.	Washers, bronze and steel
Screw sectors.	Worm wheel
Slotted sectors.	

Q. Explain how to attach and adjust the firing mechanism.

A. Clasp the hinged collar about the spindle; slip the safety bar into the notch of the housing; hold the housing over the hinged collar and screw the latter into the housing until the spring catch engages. While doing this, see that the guide bar enters the groove in the breechblock and the pin of the safety bar slide enters the hole of the safety bar.

Put the ejector in place with the ejector raised and the slide stop pulled out. Place the slide in position.

Q. Take off and put on the firing mechanism.

NOTE.—To avoid accident through a premature explosion, the greatest care must be taken of the firing mechanism.

It should be frequently tested with an unfired service primer and *must* always be so tested before service practice.

To test, insert an unfired service primer and rotate the breechblock slowly and completely to its firing position, having, during this rotation, a strong steady pull on the lanyard, sufficient to fire the primer. Should the primer fire, report the fact at once to the battery commander.

Q. Explain how the breechblock of a major-caliber gun is dismantled.

A. Open the breech, remove firing mechanism. Place shot truck with its tray under mushroom head, elevating the tray until it bears the weight of the mushroom head and spindle (have the tray covered with burlap so as to protect the mushroom head from scratching). Remove spindle nut and bronze and steel washers (or ball bearings or spindle springs)\* and,

\* In guns of models 1895 and 1900 ball bearings are substituted for spindle washers. In all 14-inch guns spindle springs are substituted for spindle washers.

holding rings and pad against the mushroom head, move truck back so as to withdraw spindle from block. Splitrings, gas-check pad and filling-in-disc may now be removed. In the case of barbette carriages it is more convenient to dispense with the truck and to have two men, with or without a sling (or using chain hoist), remove the spindle.

Q. How is it then assembled?

A. To assemble, proceed in reverse order, being careful to have the countersunk portion of the pad and the shoulder on the filling-in-disc towards the mushroom head. Firing mechanism is not placed on spindle until the mushroom head is adjusted.

Q. Explain how the breechblock of a 6-inch gun (model 1903) is dismounted:

A. Open the breech, withdraw the latch retainer and remove the latch. The breechblock is now free to be translated and rotated as if it were in the breech recess. Hold the block carrier and rotate the operating lever until translation of the block is completed. Remove the firing lever-pivot-pin and pivot. Lift the firing lever out of its slot in the block carrier. Lift the spindle key out of its slot in the block carrier. If the spindle key seems to stick, move the operating lever slightly to and fro until the key is free. Continue the rotation of the operating lever until rotation of the block is completed. Detach firing cable from the firing-cable bracket. Support the housing of the firing mechanism, and with the wrench provided for the purpose, rotate the mushroom head to the left until the housing is free from the spindle, when the housing may be withdrawn to the rear by holding down the rack-lock bolt. Remove the spindle from the block and remove the spindle spring. The operating lever should now be rotated a short distance farther. This causes the teeth on the end of the stem to enter the groove provided for them in the hub of the carrier. The stem of the block may now be removed from the carrier. Slide the rack to the left out of its groove. Remove the hinge-pin nut and take off the operating lever. Support the block carrier and drive out the hinge pin, using a copper drift. The block carrier and operating spool are now free to be removed.

To remove the loading tray, press down on the tray-latch bolt and lift the tray from its place.

To dismount the lever latch, force the latch bolt upward until the stud is free of its groove. Turn the bolt 180° until the stud points to the left, when the bolt may be lowered

out of the housing, the stud passing through a groove cut in the housing for this purpose.

Q. How is it then assembled?

A. Place the hinge-lug bushing in its seat so that one of the diagonals of its rectangular interior will be perpendicular to the face of the breech. Place the carrier bushing in its seat so that one if the diagonals of its rectangular interior will lie in the plane of the carrier. Support the carrier so that its plane is perpendicular to the face of the breech, placing its lugs in position to receive the hinge pin. Place the spool between the lugs of the carrier, and turn so that the circular lower end of the roller groove faces the body of the carrier. Insert the hinge pin carefully, using no force unless positive that the rectangular holes in the spool, hinge-lug bushing, and carrier bushing are in line. Place the operating lever on the hinge pin so that the lever lies in the plane of the carrier and screw on the hinge-pin nut. Rotate the operating lever slightly to the left and enter the stem of the breechblock in the carrier until the roller enters the roller groove. Place the rack in its groove. Press the block towards the carrier, at the same time rotating the operating handle slightly to the right and entering the stud of the rack in the rotating groove. Assemble the obturator and firing mechanism housing, being careful to stop the rotation of the mushroom head when the ejector drops into its slot in the spindle. The slide must be assembled in the housing before the housing is assembled to the spindle. Rotate the opeating lever until rotation of the block is completed. Assemble the spindle key and firing lever; rotate the operating lever until translation of the block is completed. Insert the latch. On one end of the latch the dovetail projection for the latch retainer is cut away. This is the lower end of the latch. Assemble the latch retainer.

Q. Explain how the mushroom head is adjusted for firing.

A.\* Close the breech with the spindle nut loose, but not loose enough to permit slipping of the pad or split rings. Rotate the block one-half. With the mechanism in this position screw up the spindle nut as tight as it can be screwed by one man with the wrenches provided.

It is necessary to insert the end of a screw-driver in the

\* The only adjustment necessary with the 6-inch Model 1903 mechanism is, in assembling the breechblock, to turn the obturator until the rear end of the spindle is flush with the rear face of the firing mechanism housing and the mark on the spindle coincides with the mark on the housing.

opening of the nut in order to spread it sufficiently to allow its rotation without rotating the spindle.

Tighten the clamping screw on the spindle nut and rotate the breechblock until the breech is closed completely. This last operation presses the pad into its seat, due to the forward motion of the block. Then the pad should be in proper adjustment for firing; this may be tested by turning the mushroom head by hand. It should turn easily, but without play.

Q. Explain how to lubricate the gas-check pad.

A. A mixture of equal parts by weight of graphite and 4½ lubricant is applied to the entire surface and is rubbed into the pad covering with the fingers. The object is to reduce the absorption of moisture, cutting, or tearing.

#### CARRIAGES

Point out or describe the location of such of the following parts as apply to the gun carriages of your battery:

Azimuth circle.	Crosshead guides.
Azimuth pointer.	Crosshead pawls.
Base ring.	Crosshead pawl spring.
Cap squares.	Crosshead racks.
Cap square bolts.	Cylinder guides.
Chassis.	Distance ring.
Combination recoil and buffer value.	Dust guard.
Connecting pipe.	Elevating arms.
Counter balance.	Elevating band.
Counter-recoil buffers.	Elevating controller.
Counter-recoil system:*	Elevating controller crank.
Buffer cylinders.	Elevating handwheel.
Buffer springs.	Elevating motor.
Equalizing and throttling pipes.	Elevating shaft.
Pistons.	Elevating slide.
Piston rods.	Equalizing pipe.
Spring compressors.	Filling holes.
Spring rods.	Firing magneto.
Yokes.	Followers.
Counterweight.	Foundation bolts.
Crosshead.	Glands.
	Greese cups.
	Gun lever.

\* For 6-inch D. C. Models 1905, 1905 MI, and 1905 MII; and 14-inch D. C. Models 1907 and 1907 MII.

Gun lever axle.	Safety latch (in tripping apparatus).
Idler.	Subcaliber platform.
Leveling bolts.	Sighting (or Gun Pointer's platform.)
Loading Platform.	Sight Standard.
Lower roller path.	Stuffing boxes.
Manaeuver lever.	Throttling bars.
Oil holes.	Throttling pipes.
Pinch bars.	Throttling valve.
Piston.	Top carriage.
Piston rods.	Transoms.
Racer.	Traversing clutch handle
Range pointer.	Traversing controller.
Range scale.	Traversing controller crank.
Recoil buffers.	Traversing crank.
Recoil cylinders.	Traversing gear slow motion.
Recoil racks.*	Traversing motor.
Recoil roller paths.	Traversing rack.
Recoil rollers.	Traversing rollers.
Retracting clutch handle.	Tripping levers.
Retracting cranks.	Trunnion.
Retracting drums.	Trunnion bed.
Retracting gear.	Upper roller path.
Retracting hooks.	Yoke.
Retracting ropes.	
Rimbase.	
Safety firing switch.	

Q. How is the old packing removed from the stuffing box?

A. First draw all the oil from the cylinders, then with spanner wrench remove the follower and the gland. Remove the old rings of the packing, using the extractor. Examine the old packing and throw away any not fit for use. If any of the old packing is to be used, it should be put in after the new packing.

Q. How is a stuffing box repacked and adjusted?

A. Put on the piston rod one ring of Garlock's Waterproof Hydraulic packing and force it well to the bottom of the stuffing box with a wooden stick and mallet. Treat each layer the same, being careful to break joints, until six rings of new packing have been inserted, or an equal amount of old and new packing, if any of the latter has been used. Place the halves of the gland on the follower, being careful that the

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\*For 6-inch D. C. Models 1905, 1905 MI, and 1905 MII; and 14-inch D. C. Models 1907 and 1907 MII.

halves of the gland do not bind on the screw threads. No more force should be used on the spanner wrench than that of two men, *not using a pipe or any other extension of the wrench handle*; generally that of one man is sufficient.

Q. How can you tell if the stuffing box is properly tightened?

A. There should be about one inch between the flange of the follower and the part into which it is screwed.

Q. How is the recoil taken up in a disappearing gun carriage?

A. By the oil in the recoil cylinders,\* the inclination of the chassis rail, and the excess counterweight.

Q. What is the object of the moveable hand weights?

A. By varying the number used, the gun may be made to go in battery properly. If it strikes the buffers hard, when tripped, take off hand weights. If it fails to go clear in, add weights. Some disappearing carriages have no hand weights, but depend altogether on buffer valves.

Q. How are recoil cylinders filled?

A. Remove filling plugs of both cylinders and fill till they over flow, then replace plugs.

Q. What kind of oil is used in the cylinders and how much?

A. Hydrolene. ----- gallons.†

Q. What is the equalizing pipe?

A. A pipe connecting the front ends of the two cylinders.

Q. Why is it necessary?

A. To keep the pressure during recoil the same in the two cylinders and thus keep the carriage from jamming.

Q. What is the connecting pipe?

A. It is a pipe extending back from the equalizing pipe to the throttling valve, by which it is closed.

Q. What are the throttling pipes?

A. Two pipes connecting the throttling valve with the rear ends of the two cylinders.

Q. What is the object of the throttling valve?‡

\* Disappearing carriages models 1905, and MI and MII, for 6-inch guns, and models 1907 and MI for 14-inch guns, have only one recoil cylinder, which is vertical and moves with the counterweight, the piston rod being secured at its lower end.

† For amount, see table, Appendix E.

‡ In the case of disappearing carriages models 1905 and MI and MII, for 6-inch guns, and models 1907 and MI, for 14-inch guns, the amount of recoil is controlled by a recoil valve contained in the piston rod. The upper end of the rod is bored axially to receive the stem and body of the recoil valve, the action of which is as follows: At the piston head the axial bore is surrounded by two grooves, from each of which radiate four holes, and one set of four holes opens into the cylinder on each side of the piston. Oil can, therefore, pass from one side of the piston to the other in two ways,

A. Its object is to control the amount of recoil of the gun.

Q. How does the throttling valve control the recoil of the gun?

A. By opening or closing the connecting pipe and thus regulating the flow of oil from the front ends of the cylinders to the rear ends.

Q. What is the effect of closing the throttling valve of the \_\_\_\_\_-inch carriage by one complete turn?

A. It will lessen the recoil by about \_\_\_\_\_ notches.

Q. What care must be taken of the throttling valve?

A. It must always be kept clean and free from dirt and must always be locked.

Q. On carriages which have it, what is the combined recoil and buffer valve?

A. It is a double valve like two throttling valves, the recoil valve doing just what a throttling valve does. The buffer valve, by regulating the flow of oil from the rear ends of the cylinders to the front ends, controls the last motion in counter recoil, and indirectly has some effect on recoil. The recoil valve has no effect on counter-recoil.\*

Q. How are the proper settings of the recoil valve and the buffer valves determined?

A. The recoil valve, by an examination of the records of previous firing; and the buffer valve, by actual trial.

Q. What are the throttling bars?

A. They are bars of steel, placed one on each side of each recoil cylinder of a carriage and fastened in place by a line of bolts, the heads of which show along the outside of the cylinder.

---

namely, by the outside of the piston head through the diametral clearance and the throttling grooves, and by the two sets of radial holes. But the passage by the two sets of radial holes is regulated by the recoil valve body, which is a bar fitting closely in the piston rod bore and having a slot cut on its outer surface, which, when the valve is entirely open, extends from one groove to the other. As the valve body is drawn upward, the portion of the slot in the valve body open to the lower groove in the piston rod bore diminishes, so that, at the end of its upward movement, the passage between the two sets of radial holes is closed. The flow of oil being thus regulated by the valve, the recoil of the gun is controlled.

\* In the case of disappearing carriages models 1905 and MI and MII, for 6-inch guns, and models 1907 and MI for 14-inch guns, there is a counter-recoil system entirely separate from the recoil system. In this separate system, the buffers are wholly detached from the top-carriage, which comes into contact with them only as it goes into battery, when it strikes the projecting ends of the piston rods, forces them to the front against oil that passes from one side of the pistons to the other through the clearance and through equalizing and throttling pipes, and against springs, which serve, when the gun is from battery, to force the piston rods 9 (or 12) inches to the rear. There is a buffer valve which regulates the flow of oil through the pipes.

The piston head is slotted to receive the bars, which are slightly thinner at the rear than at the forward ends. The depth of the slot does not vary; but as the thickness of the bar, which fits in the slot, does vary, the opening through which the oil can pass from one side of the piston head to the other varies, being larger when the gun is in battery and the thin rear ends of the bars are in the slots, thus keeping the strain from being excessive during the time the gun is recoiling most rapidly. As the gun goes from battery, the opening grows smaller, keeping the oil pressure uniform throughout recoil.

Q. How is the carriage cared for?

A. All parts must be kept clean and free from rust. Rust on the piston rods must not be removed with sand paper, but with kerosene or emery No. 1. The retraction ropes should be oiled with light slushing oil.

Special attention must be given to the following parts:

Gun trunnions, rollers, pintle surfaces, shaft bearings, all sliding surfaces, gun lever axles, bearings, crosshead pieces, elevating racks, elevating band trunnions, crosshead guides, and all elevating, tripping and retracting mechanisms. Traversing rollers and their paths must be clean and well oiled.

Q. What is used as a lubricant for translating rollers?

A. No. 4½ lubricant and graphite.

Q. What kind of oil should be used as a lubricant on breech mechanism, threads of breechblock, breech recess, and gears, and in all oil holes?

A. Engine oil No. 1.

Q. How much oil should be used?

A. Simply enough to cover the surface with a thin coating, rubbed over with the hand. Too much oil is to be avoided, but when firing the guns, use plenty of oil on the breechblock and in breech recess.

Q. What kind of oil should be used in bores of guns and as a lubricant for crosshead guides and traversing and recoil rollers and their paths?

A. Light slushing oil, when fresh.

Q. What other lubricant may be used for traversing rollers?

A. A mixture of engine oil No. 1 and graphite, if light slushing oil is not satisfactory.

Q. What kind of oil will be used as a preservative in case the gun remain unused for a considerable time?

A. Light slushing oil.

- Q. How is light slushing oil applied?  
A. By means of paint brushes in a light thin coat.
- Q. How can light slushing oil be removed?  
A. By means of waste or burlap dipped in kerosene oil.  
Old hydrolene also is suitable.
- Q. How is the bore cleaned after firing?  
A. By use of water. The bore should be permitted to drain and then be wiped dry before applying light slushing oil [See paragraph 440, page xix of Appendix "B"]
- Q. Explain the adjustment of the grease cups.  
A. Be careful that no grit, or dirt, gets into them. Fill them with Lubricant 4½ to the bottom of the bevel at the top of the cup. In putting on the cap be sure that the leather-packed follower enters the cup properly and is not caught nor bent. Screw the cap down until the spring rod projects about  $\frac{1}{4}$  of an inch above the head of the cap. In cold weather, it may be necessary to use a wrench to screw the cap down.
- Q. How can you tell when the cup is ready to be refilled?  
A. When the cap is screwed well down and the spring rod does not project.

## (d) POWDERS, PROJECTILES, PRIMERS, AND FUSES\*

### POWDERS†

- Q. What kind of powder is used in guns?  
A. Smokeless, nitrocellulose.
- Q. What is nitrocellulose?  
A. It is nitrated cotton. That is, it is what results when dry cotton is immersed in nitric acid. What also, is formed. Sulphuric acid absorbs water. Sulphuric acid is used in the mixture to absorb the water formed and keep the nitric acid from being diluted.
- Q. What are the next steps in making nitrocellulose powder?  
A. 1. Washing excess acid from the nitrocellulose;  
2. Dissolving the nitrocellulose in a mixture of alcohol and ether;  
3. Compressing the material after evaporating the alcohol and ether;  
4. Rolling it into sheets or pressing it into rods or tubes;  
5. Cutting up the sheets, rods, or tubes into grains;  
6. Drying the grains.
- Q. What is the form of its grains?  
A. Perforated cylinder.
- Q. What is the weight of the service charge for a gun of the model and caliber in your battery?  
A. ----- lbs.‡
- Q. What is *Combustion*, *Ignition*, *Inflammation*, *Explosion*?  
*Combustion* is the burning of a grain of powder, or wood, or coal, from the surface of ignition inward or outward or both.  
*Ignition* is the setting on fire of a part of the grain or charge.  
*Inflammation* is the spread of the ignition from point to point of the grain, or from grain to grain of the charge.  
*Explosion* is rapid combustion. It is the rapid conversion of gunpowder into gases and solids. (When this conversion is very rapid and accompanied by a crashing or shattering effect, it is called *detonation*.)

\* See Ordnance pamphlet No. 1872 of 1915.

† See Ordnance pamphlet No. 1888 of 1914.

‡ See table in Appendix "E" for all models.

- Q. What is the object of the igniting charge?  
A. To secure a quicker ignition of the smokeless powder.
- Q. Where is the igniting charge located?  
A. An igniter, or igniting charge, is quilted in each end of each charge, and is also placed in the cloth tube connecting the ends. This tube filled with black powder is called a core igniter.
- Q. What kind of powder is used as igniting charge?  
A. Black powder.
- Q. How is powder stored?  
A. In hermetically sealed cases in magazines.
- Q. What is the normal muzzle velocity of the gun of the model in your battery, with service charge?  
A. ----- foot-second.\*
- Q. In 10- and 12-inch guns, will a given powder charge give the same velocity in model 1895 guns as in the Model of 1888?  
A. No. 15 foot seconds less velocity is to be expected in the 1888 models than in an 1895.
- Q. Should powder for one caliber gun ever be used in one of a different caliber?  
A. No. It is prohibited.

## PROJECTILES†

- Q. What are the projectiles used in your battery?  
A. Armor-piercing shot and shell, capped; cast-iron shot and shell, capped.
- Q. Their weights?  
A. Long point-----lbs.\* Short point-----lbs\*
- Q. What is the difference between shot and shell?  
A. The shell is longer than the shot. They weigh the same. While both have cavities inside, yet the cavity in the shell is larger; so the shell carries a larger bursting charge. The walls of the shot are thicker than those of the shell; so the shot has greater strength to penetrate armor without breaking up.
- Q. What projectile is used for target practice and why?  
A. A cast-iron projectile of the same shape as an armor-piercing projectile. The cast-iron is cheaper.
- Q. How may target practice projectiles be readily distinguished from service projectiles?

\* See table in Appendix "E" for all models.

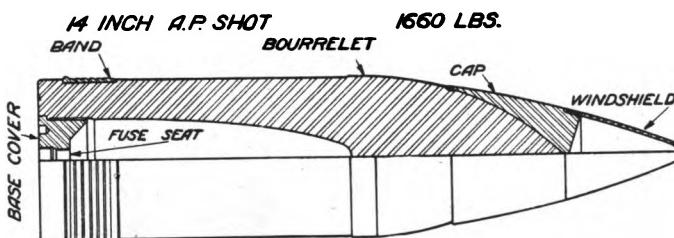
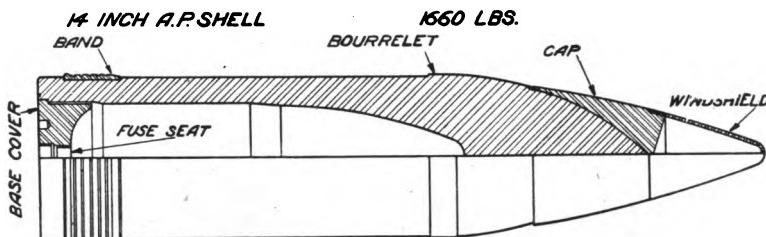
† There are 7000 grains in a pound.

‡ For instructions for loading, see Appendix "F".

A. Target practice projectiles have a second band of olive green midway between the center-of-gravity band and the rotating band.

Q. What does the painted band around the center of the projectile indicate?

A. The center of gravity of the projectile, the metal of which made, and the place at which the shot tongs should be hooked.



Q. What do two painted bands on the projectile indicate?

A. A target practice projectile.

(Steel projectiles which are assigned for target practice purposes will be painted the same as cast-iron shell except that the rear of the rotating band will be painted blue gray.)

Q. What color indicates cast iron?

A. Olive green.

Q. What color indicates cast steel?

A. Warm gray.

Q. What color indicates forged steel?

A. Blue gray.

Q. What is indicated by the width of the gray portion of the ogive?

A. Whether the projectile is A. P. shot or A. P. shell.

- Q. How much of the ogive will the A. P. shot have painted gray?  
A. All of it.  
Q. How much of the ogive of the A. P. shell will be painted gray?  
A. Two-thirds of the ogive of blunt-capped shell, including the cap and measured from the point. In the case of long pointed projectiles, the wind shield only is painted.



12-INCH SHELL WITH OLD MODEL CAP

12-INCH SHELL WITH NEW MODEL  
LONG POINTED CAP

- Q. What does the color of the paint on the base indicate?  
A. The kind of bursting charge the projectile contains.  
Q. What color indicates Explosive D as bursting charge?  
A. Deep yellow.  
Q. How is the fact that a projectile is not fused indicated?  
A. By four longitudinal black stripes about one inch wide painted over the yellow in rear of the rotating band and

equally spaced around the projectile. If the base cover happens to be in place, the stripes may extend entirely across it.

Q. What color indicates rifle (black) powder as bursting Charge?

A. Red.

Q. Using diagram of a projectile, point out the following: The windshield, the armor-piercing cap, the bourrelet, the base cover, the rotating band, the fuse seat.

Q. What is the object of the armor piercing cap?

A. To prevent the point of the projectile from bending or breaking when the projectile strikes against armor.

Q. What is the object of the ballistic cap (windshield)?

A. To give a shape to the head of a projectile which will reduce to a minimum the resistance of the air on the projectile.

Q. What is the object of the rotating band?

A. To give rotation to the projectile and thus prevent it from tumbling in the air, and to act as a seal to prevent the powder gases from escaping around the projectile.

Q. How should projectiles be piled?

A. Projectiles will always be piled on skids, with no weight resting on rotating bands, with point to the wall, and base out so they may be easily inspected and fused in case of necessity.

Projectiles for target practice must never be piled with those intended for service.

Projectiles will be painted as required by regulations, and in case the galleries are wet the projectiles after painting will be slushed. Skids or strips of wood should be placed between layers, and every care taken to prevent injury to rotating bands.

Q. What is the weight and caliber of subcaliber projectiles for guns?

A. Weight, 1.1 pounds. Caliber, 1.46 inches.

Q. What does the Lot Number on an armor piercing projectile indicate?

A. The kind of projectile and the kind of fuse to be used in it.

Q. Where on the projectile is the lot number found?

A. It is stamped on the rotating band with steel dies. It is also stenciled on the base cover with paint after the projectile has been fused.

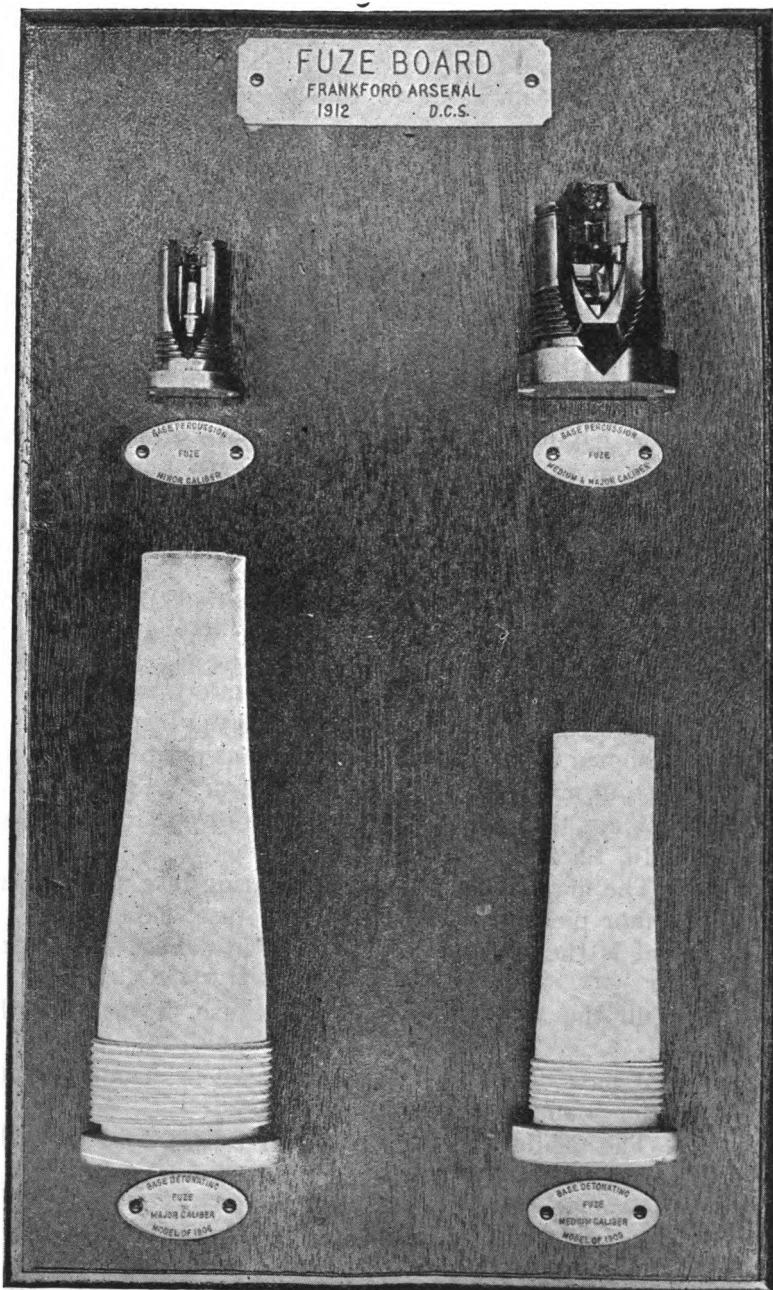
(NOTE.—Various marks and numbers found on other parts of a projectile should be disregarded.)

- Q. What is the name of the explosive used in all our armor piercing projectiles?
- A. Explosive D.
- Q. What is the appearance of explosive D.?
- A. It is a dark yellow, or orange color, powder.
- Q. How is it loaded in the projectile?
- A. By hand, using suitable ramming tools.
- Q. By whom are projectiles loaded?
- A. All projectiles for 5, 6, 8, 10, and 12-inch guns and 12-inch mortars are loaded by Coast Artillery troops. (See Artillery Note No. 35; Ord. Pamphlet No. 1721 and Sup.; and App. "F")

#### FUSES\*

- Q. What is a fuse?
- A. A fuse is the device used to ignite the bursting charge of a projectile at any point of its flight, or upon impact.
- Q. What is the difference in purpose between a fuse and a primer?
- A. A fuse ignites the bursting charge in the projectile; a primer ignites the propelling charge in the gun or mortar.
- Q. How are fuses classified according to their types?
- A. According to method of arming:
- Ring resistance.  
Centrifugal.
- According to method of operation:  
Combination time and percussion.  
Detonating.
- According to location in the projectile:  
Point.  
Base.
- Q. What class is used in armor piercing projectiles?
- A. The base detonating fuse.
- Q. What base detonating fuses are used in armor piercing projectiles for 8, 10, 12, and 14-inch seacoast guns?
- A. (1) The major caliber base detonating fuse; (2) The armor piercing base detonating fuse.
- Q. Of these two which is the later model?
- A. The major caliber base detonating fuse. (See "Fuse Board, Frankford Arsenal, 1912.")

\* See Ordnance pamphlets No. 1727 (latest revision, 1913) and 1872 (latest revision, 1915); see also "Fuze Board, Frankford Arsenal, 1912."



Department of Enlisted Specialists C. A. S.

Q. What is intended as to future supply of the other one?

A. No more will be issued after the present supply has been used up.

Q. In A. P. *shot* for 8, 10, 12, and 14-inch guns which fuse is used?

A. The major caliber base detonating delay action fuse.

Q. In A. P. *shell* for 8, 10, 12, and 14-inch guns which fuses are used?

A. Either the non-delay action major caliber b.d.f. or the non-delay action A.P. b.d.f., *depending on the lot number of the shell.*

Q. How can you tell from the lot number whether a projectile has a delay or a non-delay action fuse?

A. Those having delay action fuses are odd numbered; those having non-delay action fuses are even numbered.

Q. What plunger is used in all A.P. and D.P. projectiles in service?

A. The Semple centrifugal plunger.

Q. In what respect do the plungers used in the major caliber base detonating fuse and the A.P. detonating fuse for A.P. shot and shell for guns differ from the plungers used in fuses of the same types for D.P. shell for mortars?

A. The Semple centrifugal plungers of the fuses for use in guns are designed to arm at 2000 revolutions per minute, while those for use in mortars are designed to arm at 1300 r.p.m.

Q. What are the lengths of the two fuses used in projectiles for 8, 10, 12, and 14-inch guns?

A. (1) The major caliber base detonating fuse, 6.7 inches; (2) The armor piercing base detonating fuse, 9.35 inches.

Q. What is the purpose of the plug in a base detonating fuse?

A. To fill the seat in which, before use, is inserted the plunger.

Q. What base detonating fuses are used in armor piercing projectiles for 5 and 6-inch seacoast guns?

A. (1) The medium caliber base detonating fuse: (2) The siege (base) detonating fuse.

Q. Of these two which is the later model?

A. The medium caliber base detonating fuse. (See "Fuze Board, Frankford Arsenal, 1912.")

Q. What is intended as to the future supply of the other one?

A. No more will be issued after the present supply has been used up.

Q. In A.P. *shot* for 5 and 6-inch guns which fuse is used?

A. The medium caliber base detonating delay action fuse, except in Armstrong shot, in which will be used the non-delay action fuse.

Q. In A.P. *shell* for 5 and 6-inch guns which fuses are used?

A. Either the non-delay action medium caliber b.d.f. or the non-delay action siege (base) d.f., *depending on the lot number of the shell*.

Q. What are the lengths of the two fuses used in projectiles for 5 and 6-inch guns?

A. (1) The medium caliber base detonating fuse, 4.75 inches; (2) the siege (base) detonating fuse, 6.6 inches.

Q. How do you make a tight joint in assembling a fuse in a projectile?

A. Vaseline is placed in the threads of the fuse hole and on the threads of the fuse and screwed up tight. As an additional precaution a base cover is added.

NOTE.—The work of inserting fuses in projectiles is exceedingly dangerous and should be done strictly in accordance with "Instructions for Loading Projectiles." (See Appendix "F.")

Q. What is the object of the tight joint, and of the base cover?

A. To prevent premature explosion of the bursting charge by gases entering from the propelling charge on explosion of latter.

#### PRIMERS\*

Q. What is a primer?

A. A primer is a device used to ignite the powder charge in the gun.

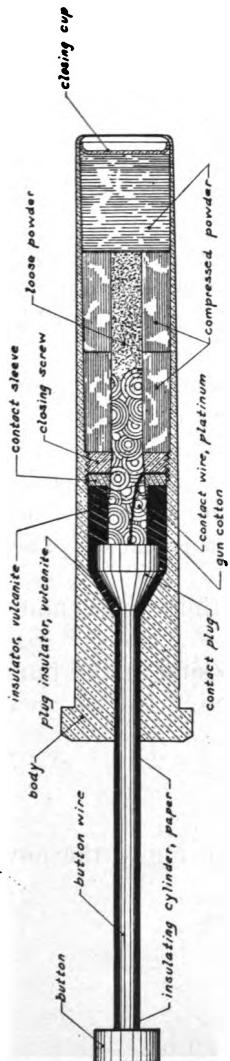
Q. Name the classes of primers.

- A. 1. Drill.
- 2. Friction, Model 1914.
- 3. Simple electric.
- 4. Combination electric-friction.
- 5. Percussion.
- 6. Igniting.

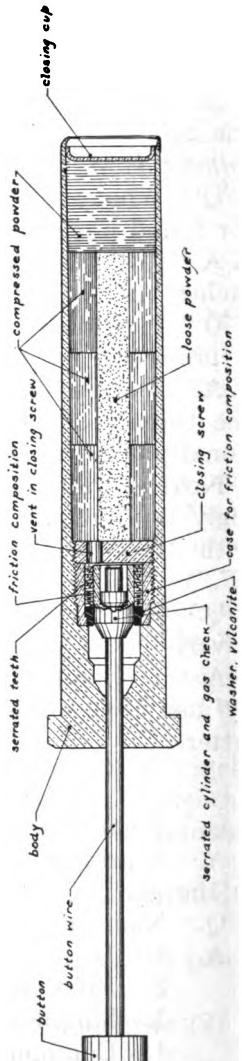
Q. What primers do you use at your battery?

\* See Ordnance pamphlet No. 1881 (newest edition, 1915; see also "Primer Board, Frankford Arsenal, 1912.")

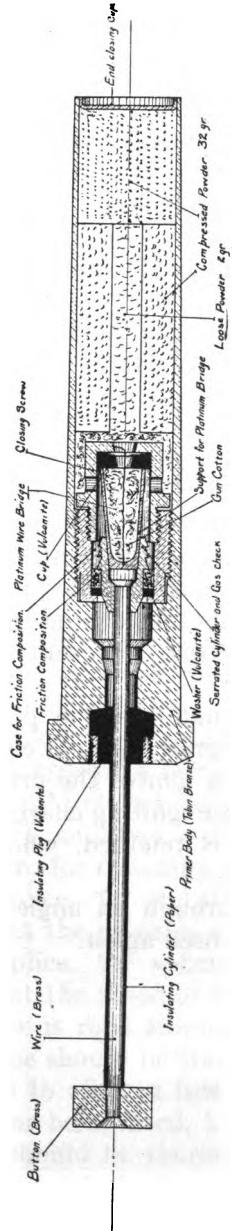
## ELECTRIC PRIMER



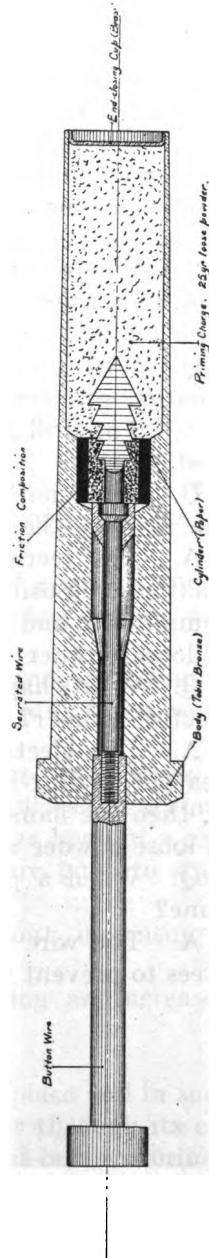
## FRiction PRIMER



# COMBINATION - PRIMER ELECTRIC - FRICTION



# DRILL - PRIMER - FRICTION -



A. Drill primer, friction, simple electric, combination electric-friction primer, and 20-grain igniting primer.

Q. When is each used?

A. The drill primer is used in drill and in sub-caliber practice; the simple electric primer and the friction primer in service practice and in action; the combination electric-friction primer in subcaliber practice; and the 20-grain igniting primer in the base of the subcaliber ammunition.

Q. Where is the percussion primer used?

A. In fixed ammunition, such as for small arms and the 3-inch gun.

Q. Why are drill primers furnished in addition to combination primers and friction primers Model 1914?

A. The drill primer is much cheaper and can be loaded at post.

Q. What happens when the wire of the primer is pulled to the rear by the lanyard?

A. The teeth at the inner end are pulled through the friction composition. This makes enough heat to ignite this composition and the flame from this ignites the priming charge of loose powder which fires the igniting charge in the gun.

Q. What happens when electricity is sent through an electric primer?

A. The electricity going through the fine platinum wire heats it until it is hot enough to ignite the gun cotton around it, then the flame from this cotton ignites the priming charge of loose powder which then fires the igniting charge in the gun.

Q. When a primer fails and is rejected, what should be done?

A. The wire should be bent through an angle of 180 degrees to prevent the primer being used again.

## (e) CORDAGE, BLOCKS, GINS, SHEARS, AND JACKS

### CORDAGE

Q. Define yarn, strands, jaws of a rope.

A. A yarn is a thread of hemp or other fibrous material.

A strand is a number of yarns twisted together.

The jaws are the spaces between the strands of a rope.

Q. Make a square knot; bowline; anchor knot; rolling hitch; blackwall hitch; round turn and two half hitches; clove hitch; long splice; short splice. Explain the use of each.

A. Square knot, for joining the ends of two ropes of the same size. (Note.—If the pull is on diagonal corners, this knot readily slips and is called a *thief knot*.)

Bowline, for forming a loop at the end of a rope which will neither draw up, become loose, nor jam when wet or under heavy strain.

Anchor knot, for fastening a rope to an anchor or ring. It will neither draw up, become loose, nor jam when wet or under a heavy strain.

Rolling hitch, for fastening a rope to a strap or tail block, and to secure a fall while being shifted on a windlass or capstan.

Blackwall hitch, for fastening a rope to the hook of a block. Round turn and two half hitches, to secure guys to stakes.

Clove hitch, for fastening a rope to a spar.

Long splice, for splicing a rope without increasing its diameter at the place of splice.

Short splice, for splicing a rope allowing an increase in diameter at the place of splice.

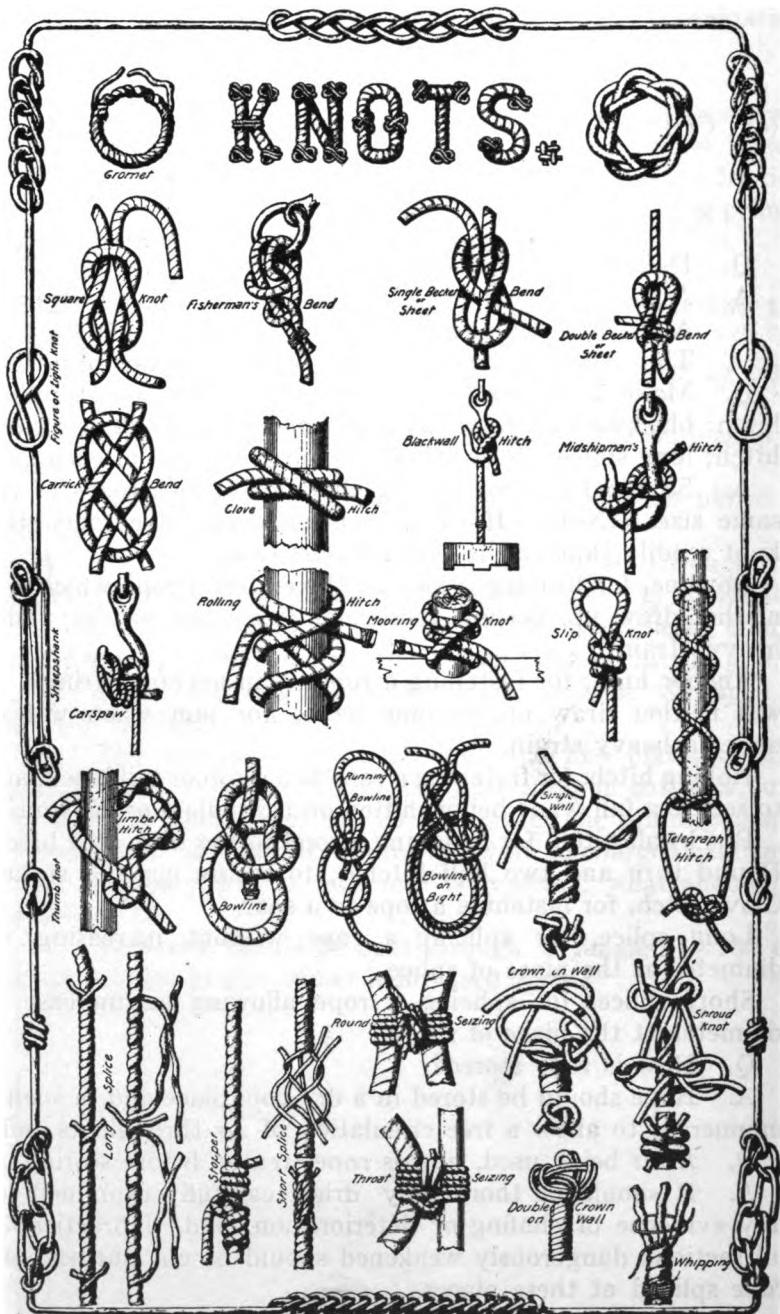
Q. How is rope stored?

A. Rope should be stored in a dry cool place and in such a manner as to allow a free circulation of air through its coils.

Q. After being used, how is rope treated before storing?

A. It should be thoroughly dried, carefully examined for any evidence of chafing or deterioration, and, if practicable, all sections dangerously weakened should be cut out and the rope spliced at these places.

Q. What is whipping?



A. Wrapping the end of a rope with twine to prevent its unraveling.

Q. What is splicing?

A. Joining the ends of ropes by intertwining the strands.

Q. What is worming?

A. Filling the jaws of a rope by laying spun yarn on marline along them, to render the surface smooth for parcelling and serving.

Q. What is parcelling?

A. Wrapping (with the lay of the rope) with narrow strips of canvas so as to protect a rope.

Q. How do you serve a rope?

A. By worming, then parcelling, and finally laying on spun yarn or other small stuff around the rope in turns close together against the lay of the rope.

Q. What is a strap, or sling, and for what is it used?

A. It is formed by knotting or splicing together the ends of a short rope. It is used for hooking tackles into.

Q. Mouse a hook and explain its purpose.

A. It is seizing placed around the jaw of a hook to prevent it from spreading or unhooking.

#### BLOCKS

Q. Name the different parts of a block and point them out.

A. Shell, sheave, pin, strap, eye, thimble, hook, bolt.

Q. Mention the different kinds of blocks.

A. Single, double, treble, snatch, and tail blocks.

Q. What is a purchase?

A. A purchase in cordage is a tackle of any kind for giving power.

Q. What is a tackle?

A. It is a purchase formed by rigging a rope through one or more blocks.

Q. Point out the running part, the standing part, and the fall.

Q. Reeve the following: Whip, gun tackle, luff.

A. See illustration (page 26).

Q. What is meant by the power of a tackle?

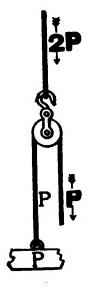
A. The number obtained by dividing the weight raised by the force applied on the fall necessary to balance the weight. In an ordinary tackle the number of ropes pulling upon the movable block is the "power."

Q. Examine a triplex block and explain its use.

A. A triplex block is a device used to lift a heavy weight with the use of a small amount of power.

For many purposes it is much better than any form of tackle.

It consists of a train of gears operated by a large wheel over which passes a light chain. Power is applied to this chain. The gears operate a small wheel or sprocket, over which runs a heavy chain. The heavy chain raises the weight. A hook is bolted to one side of the casing for attaching the block to a crane or davit.



WHIP TACKLE



GIN TACKLE



LUFF TACKLE

## GINS

Q. Describe a gin.

A. A gin is a tripod formed of three poles. The two outside ones are called legs, the third one the pry pole. A gin requires no guys.

Q. What is it used for?

A. For lifting weights *vertically*.

Q. Name the different parts of a garrison gin.

A. Two legs, pry pole, bolt and clevis, windlass and ratchet, two hand spikes, three shoes, two braces, and tackle.

Q. How much can be safely lifted with it?

A. 17,000 pounds.

Q. Explain briefly how it is assembled and raised.

A. The legs and pry pole are laid on the ground with the heads together and in position for assembling.

The head is then assembled by putting the pin through the pry pole, clevis, and legs. The windlass is put in place and the braces are brought up and put in their places.

The gin is raised, after being put together, by raising the head and bringing up the foot of the pry pole towards the feet of the other two legs.

Q. How can the upper block be placed in position after the gin has been raised?

A. By rigging a trace rope through the clevis of the gin and shell of the block and hoisting it up.

Q. What are the principal uses of the garrison gin?

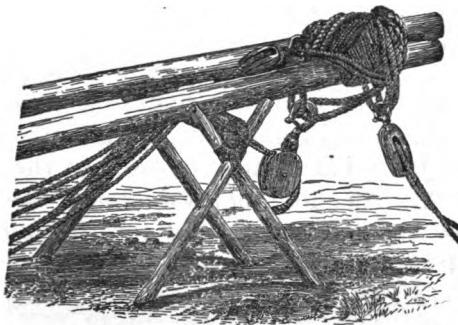
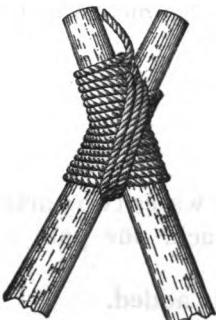
A. For lifting vertically any weights within its capacity. It is designed especially for use around the gun and mortar emplacements.

#### SHEARS

Q. Describe shears.

A. Shears consist of two spars, of a size suitable for the weight to be raised, lashed together at the cross. A tackle is fastened to the lashing by a strap or otherwise; the hook is moused; and holdfasts are required.

Q. What are shears used for?



SHEAR LASHING  
(SEE ENGINEER FIELD MANUAL, FIGS. 78 AND 79.)

A. Shears are used for lifting heavy weights to move them a short distance, as in loading or unloading a ship or railroad car.

Q. How is a shear lashing made?

A. The two spars for the shears are laid along side of each other with their butts on the ground, the points below where the lashing is to be resting on a skid. A clove hitch is made around one spar and the lashing is taken loosely eight or nine times about the spars above it without riding. A couple of frapping turns are then taken between the spars and the lashing is finished off with a clove hitch above the turns on one of the spars. The butts of the spars are then separated, a sling (or strap) is passed over the fork, to which the block is hooked or lashed, and fore and rear guys are made fast with clove hitches to both spars just above the fork.

Prepare the holdfasts for the foot ropes, to prevent the heels from slipping while raising, and for the guy ropes when the shears are ready for raising.

Q. How are shears held in position after being raised?

A. By means of guys.

Q. How are the shears raised?

A. If not too heavy, lift the head and haul in on the proper guys. If too heavy to raise in this way, form a crutch by lashing together two poles near their upper ends, the feet of the crutch being slightly in rear of the heels of the shears and secured to prevent them from slipping. Lay the rear guy over the crutch and raise the crutch by means of two light guy ropes, until it is inclined at an angle of about 45° to the front. Haul on the rear shear guy, allowing the crutch to rise as the shears rise. After the shears are raised high enough so that the crutch ceases to act, it is lowered by means of its guy ropes.

#### HYDRAULIC JACKS

Q. For what is a hydraulic jack used?

A. For lifting heavy weights.

Q. What liquids are used in the jacks?

A. Alcohol (*not wood alcohol*) one part and water two parts, for the base jack; and for the horizontal jack, one part of alcohol and one part of water.

In each case a tablespoonful of sperm oil is added.

Q. How is the jack filled?

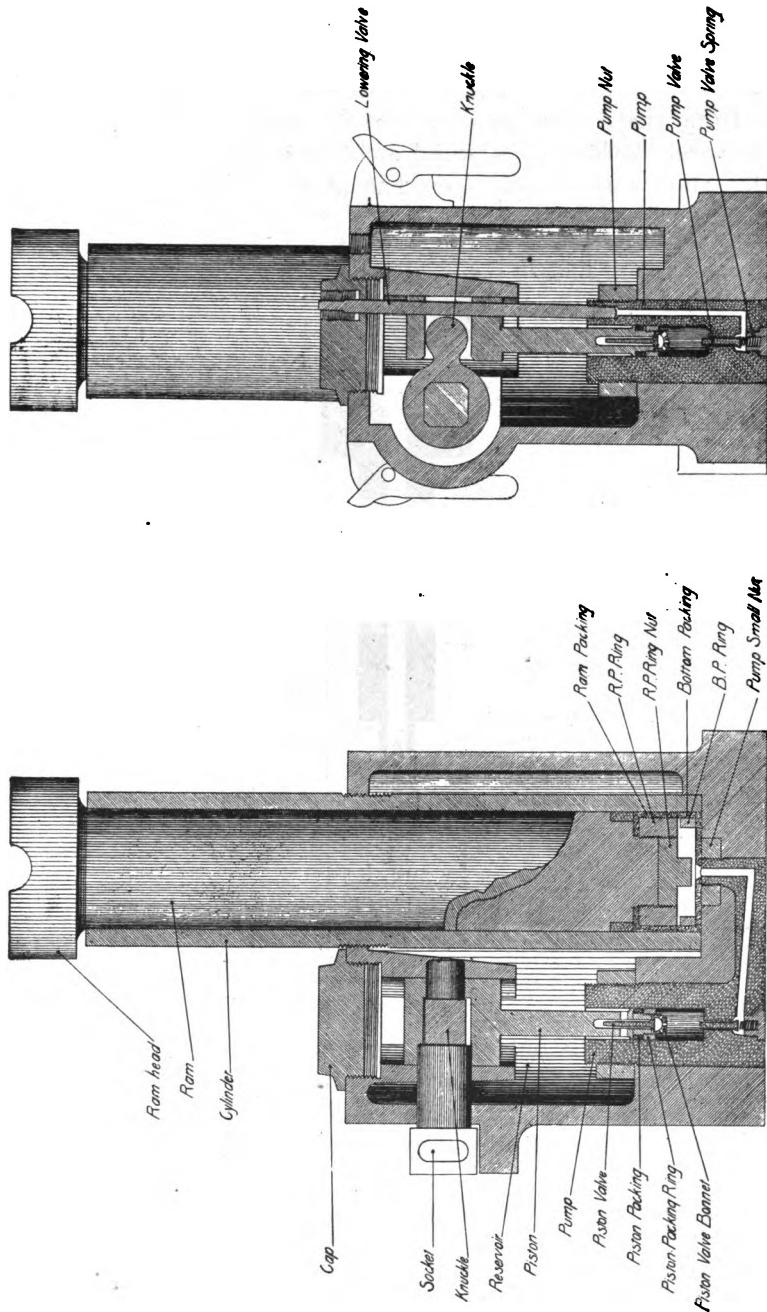
A. After cleaning, fill through the large hole, replace hexagonal cap, and then the lowering valve. In case it is necessary to add a little liquid to replace that which has leaked out, and at the place of work, remove small screw, fill, and replace the screw. This is to prevent sand from entering the pump mechanism. The ram should be down in both operations.

Q. How is the jack emptied?

A. With the ram down, place the finger over the escape hole in the cylinder, pump the ram until the bottom of it is above the hole, then open lowering valve, remove the finger, and allow the air to enter under the ram. The ram can now be easily pulled out.

Remove the lowering valve and hexagonal cap and invert jack to allow liquid to run out.

(NOTE.—If the jack has lowering valve near bottom, only the cap need be removed.)

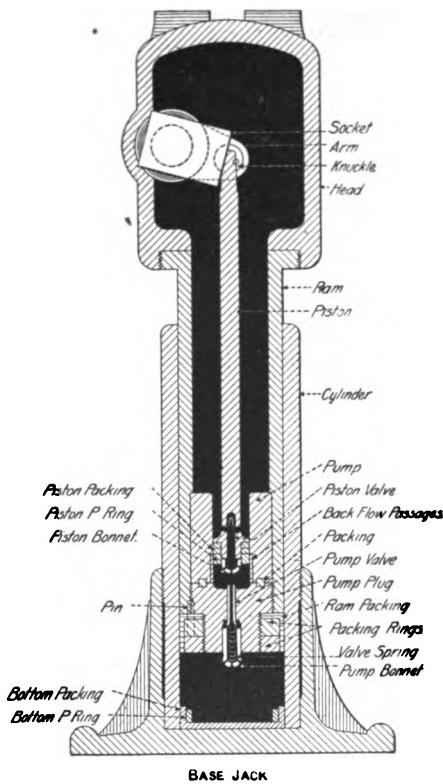


***Caution.***—Always insert the lever in the socket with the projection down.

Q. How is a jack cared for when not in use?

A. The jack should always be kept filled and clean and free from rust. The ram should be kept down. Never fill with water, kerosene, or wood alcohol, which cause it to rust.

Q. Show how a jack is used in moving a heavy weight.



A. See that the bottom of the jack has a firm bearing surface, and that the top of the ram presses securely against the weight to be moved. Tighten the lowering valve, and work the handle with a slow, steady stroke, and follow the weight up closely with the blocking.

Q. What is the difference, if any, in the use of a base and a horizontal jack?

A. A horizontal jack may be used equally well in a horizontal or an upright position. A base jack may be used standing or at an angle, with the limitation that the head

must be a little higher than the foot, so that the pump will be always submerged.

Q. How is a heavy weight lowered with a jack?

A. Care must be taken not to let the ram down too fast nor to check it too suddenly. Loosen lowering valve very slowly, bearing in mind that to avoid accident the weight must be "followed down" with blocking.

Q. How is a claw used with a jack?

A. When it is impossible to get the head of the jack under the weight, a claw is used. One end is placed under the object to be raised and the other end of the claw over the head of the jack.

(f) U. S. MAGAZINE RIFLE

Q. Point out the following parts:

Barrel.	Firing pin sleeve.
Front sight.	Striker.
Stacking swivel.	Main spring.
Stock.	Extractor.
Upper band.	Safety lock.
Lower band swivel.	Cut-off.
Grasping groove.	Cocking piece.
Hand guard.	Ejector.
Rear sight.	Magazine.
Movable base.	Floor plate.
Windage screw.	Guard.
Windage scale.	Trigger.
Drift slide.	Lower band.
Slide.	Butt swivel.
Slide screw.	Butt plate.
Range scale.	Bayonet.
Bolt.	Bayonet guard.
Bolt handle.	Bayonet grip.
Locking lug.	Bayonet catch.
Sleeve.	Oiler and thong case.
Firing pin.	Brush and thong.

Q. Describe the bullet for ball cartridge.

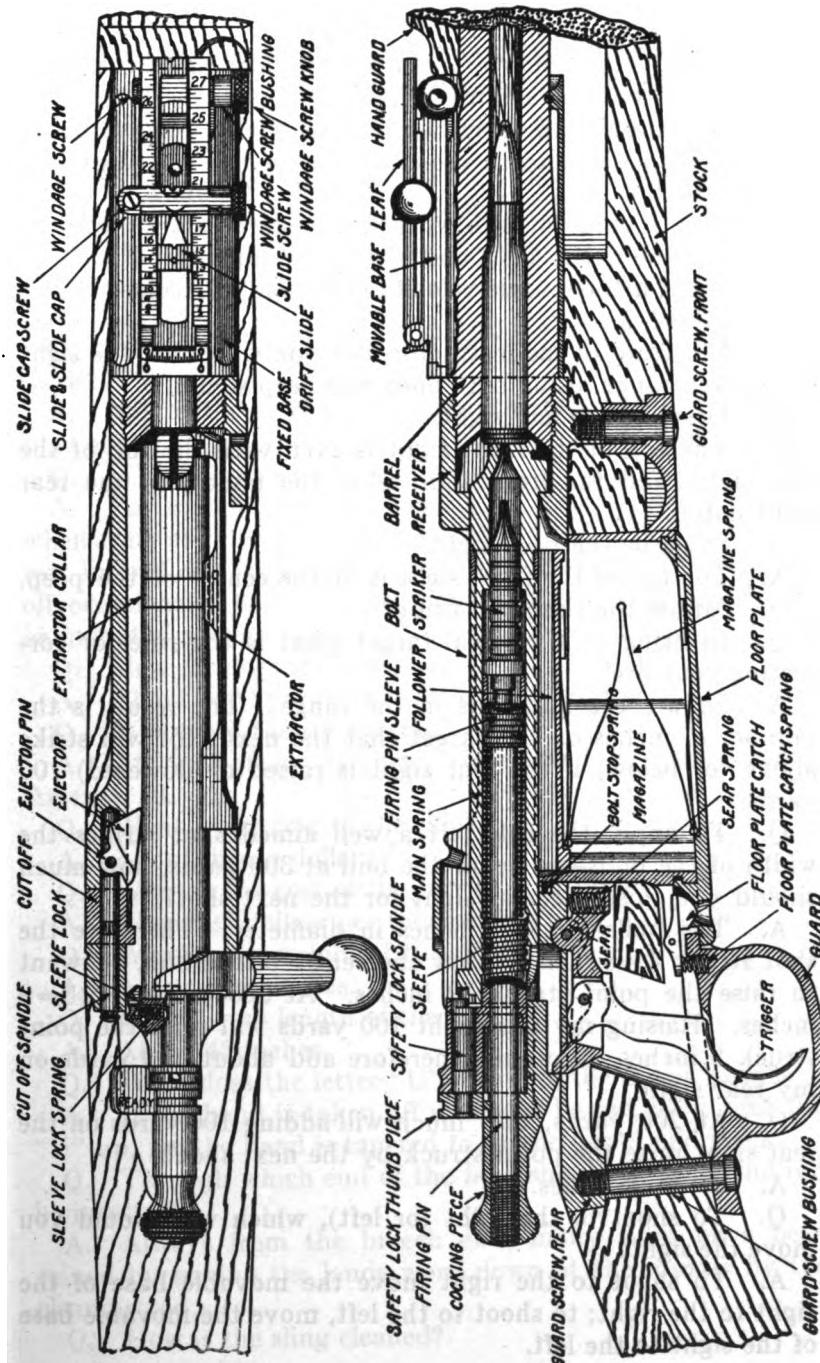
A. It has a core of lead and tin composition inclosed in a jacket of cupro-nickel. The point is very sharp so as to offer little resistance to the air.

Q. Describe the bullet for the old style blank cartridge.

A. The bullet is of paper, hollow, and contains a charge of smokeless powder, which insures the breaking up of the bullet on leaving the bore.

Q. Describe the bullets for the dummy and guard cartridges.

A. The same as the bullet for the ball cartridge. To distinguish it from the ball cartridge, the dummy cartridge has a tinned case provided with six long straight grooves along it and three holes through it. The guard cartridge is distinguished from the ball cartridge by having either 5 grooves



around the case (old style), or six short straight grooves at the shoulder (new style).

Q. What is the shortest range at which dummy ammunition should be used against persons?

A. It is prohibited to fire at persons within 100 yards.

Q. What is the muzzle velocity of the guard cartridge?

A. 1200 f. s.

Q. How should you aim when firing guard cartridges?

A. Use the battle sight and aim at the hips.

Q. What is the muzzle velocity of the ball cartridge?

A. 2700 f. s.

Q. Illustrate to the instructor how you would set the sight for a given range, using both open and peep sights.

Q. Describe the half sight.

A. The top of the front sight is even with the top of the rear sight, and the front sight is in the middle of the rear sight notch.

Q. Describe the peep sight.

A. The top of the front sight is in the center of the peep.

Q. Adjust the sling for firing.

Q. In firing at a vertical target what is the rule for correcting your fire?

A. Square the hundreds in the range. The result is the number of inches on the target that the next shot will strike above (or below) if the rear sight is raised or (lowered) 100 yards.

Q. To apply the rule: If a well aimed shot strikes the width of the bulls-eye below the bull at 300 yards, how much should you raise the rear sight for the next shot?

A. The bulls-eye is 8 inches in diameter. Therefore the shot struck  $4+8$  inches below the center of the bull. I want to raise the point struck 12 inches. At 300 yards,  $3 \times 3 = 9$  inches. Raising my rear sight 100 yards will raise the point struck 9 inches. I would therefore add about 130 yards on my rear sight.

Q. At 200 yards, how much will adding 100 yards on the rear sight raise the point struck by the next shot?

A.  $2 \times 2 = 4$  inches.

Q. To shoot to the right (or left), which way would you move the sight?

A. To shoot to the right move the movable base of the sight to the right; to shoot to the left, move the movable base of the sight to the left.

Q. How much does one point on the windage scale correct for?

A. Slightly over 4 inches for every 100 yards of range; so at 300 yards range one point corrects for about 13 inches.

Q. What is the range of battle sight?

A. About 550 yards.

Q. In firing with battle sight, how high is the trajectory above the line of sight at 200 yards?

A.  $2\frac{1}{4}$  feet.

Q. At 300 yards?

A.  $2\frac{1}{2}$  feet.

Q. How do you aim in using battle sight at less than 550 yards?

A. Aim at the earth just beneath the target or at the lower edge of the target.

Q. What oils can be used on rifles?

A. For metallic surfaces: sperm oil, cosmic, or "3 in 1"; when arms are stored, cosmic should be used. For the stock: raw linseed oil; when in the field, the stock should be wiped off occasionally with a cloth moistened with any of the oils enumerated above.

Q. How far does the rifle shoot?

A. About 5400 yards, or a little over 3 miles.

Q. Where are the rifles made?

A. At Springfield Armory, Mass., and at Rock Island Arsenal, Ill.

Q. What is the cost of the rifle?

A. About fifteen dollars.

Q. What is the cost of the service ammunition?

A. About 27 dollars per thousand.

Q. What is the weight of the rifle?

A. About  $8\frac{3}{4}$  pounds.

Q. What is the length of the rifle?

A. About 43 inches.

Q. What does the letter "U" mean on the upper band?

A. If the band is taken off it should be put back with the "U" up, for the band is tapered to fit the barrel and stock.

Q. Through which end of the bore should the cleaning rod be inserted?

A. Always from the breech end; many rifles have been ruined by having the lands worn down at the muzzle by the cleaning rod.

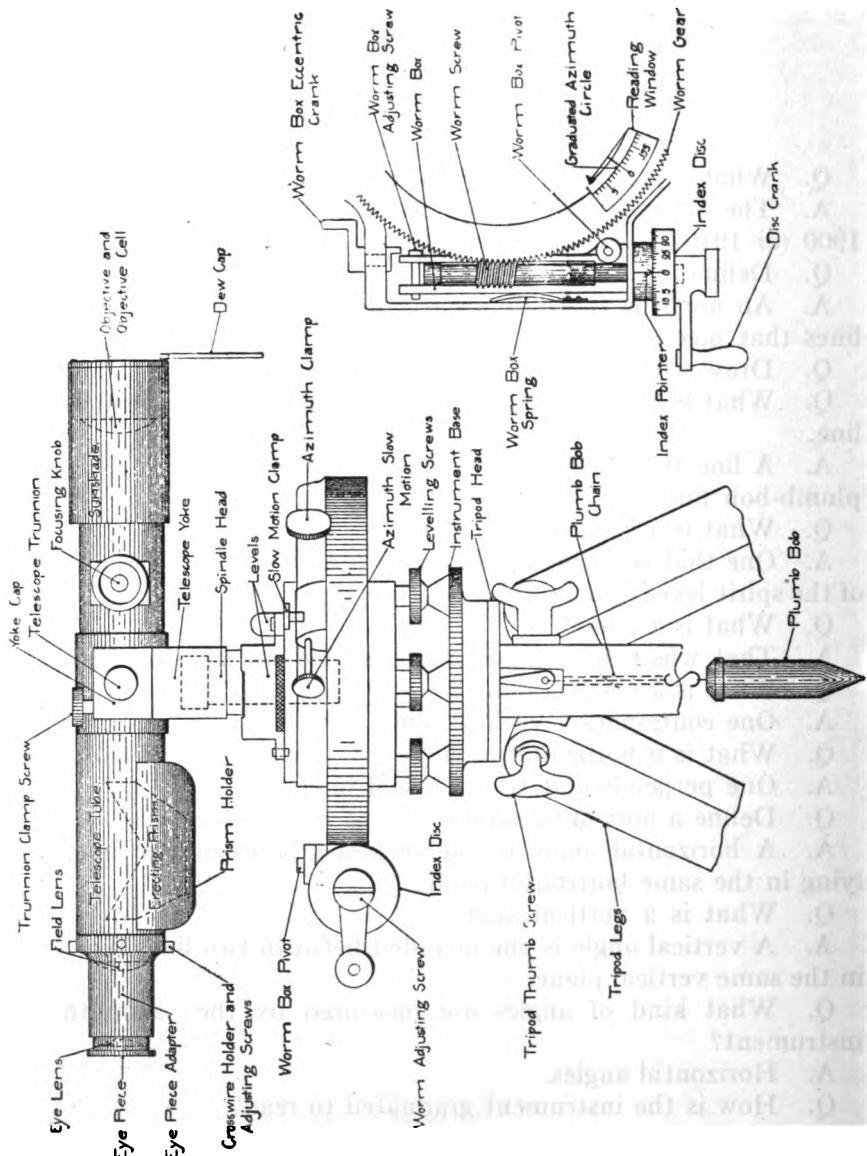
Q. How is the sling cleaned?

A. First wash with a sponge well lathered with castile soap. When partially dry, rub with a lather of harness soap. When nearly dry, rub with a dry cloth to a polish. Dry in a cool place. Never dry leather in the sun.

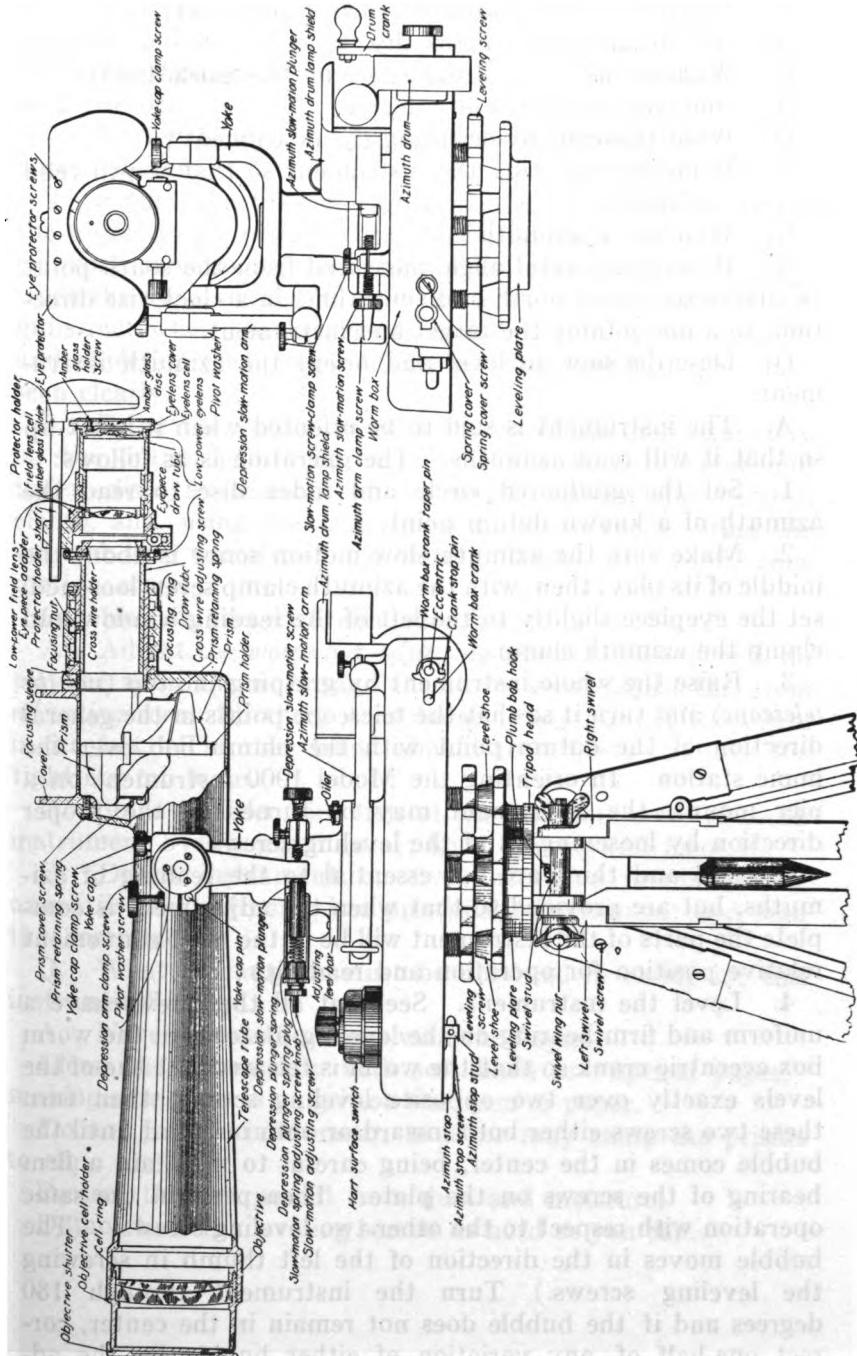
## FIRST CLASS

### (a) AZIMUTH INSTRUMENT

- Q. What is the name of this instrument?  
A. The Warner and Swasey Azimuth Instrument, Model 1900 (or 1910).
- Q. Define an angle.  
A. An angle is the difference in direction of two straight lines that meet or would meet if sufficiently prolonged.
- Q. Draw with chalk, or pencil, an example.
- Q. What is a vertical line? Give an example of a vertical line.  
A. A line that runs straight up and down; for example, a plumb-bob line.
- Q. What is a horizontal line?  
A. One that is perpendicular to a vertical line; or, the axis of the spirit level, when bubble is centered.
- Q. What is a plane?  
A. That which has length and breadth but no thickness.
- Q. What is a vertical plane?  
A. One containing a vertical line.
- Q. What is a horizontal plane?  
A. One perpendicular to a vertical line.
- Q. Define a horizontal angle.  
A. A horizontal angle is one included between two lines lying in the same horizontal plane.
- Q. What is a vertical angle?  
A. A vertical angle is one included between two lines lying in the same vertical plane.
- Q. What kind of angles are measured by the azimuth instrument?  
A. Horizontal angles.
- Q. How is the instrument graduated to read?  
A. In degrees and hundredths of a degree.
- Q. Where are the degrees read?  
A. On the graduated limb?
- Q. What is the value of a space on the limb?  
A. One degree.



AZIMUTH INSTRUMENT, MODEL 1900



- Q. Where are the hundredths of a degree read?  
A. On the graduated index disc.
- Q. What is the value of one space on the index disc?  
A. One one-hundredth of a degree.
- Q. What is meant by orienting the instrument?  
A. It means adjusting the instrument so that it will read correct azimuths.
- Q. What is an azimuth?  
A. It is a horizontal angle measured from the south point (which is zero) of a north and south line, in a clockwise direction, to a line joining the target and instrument.
- Q. Describe how to level and orient the azimuth instrument.  
A. The instrument is said to be oriented when it is set up so that it will read azimuths. The operation is as follows:
1. Set the graduated circle and index disc to read the azimuth of a known datum point.
  2. Make sure the azimuth slow motion screw is about the middle of its play; then, with the azimuth clamp screw loosened, set the eyepiece slightly to the left of the reading window and clamp the azimuth clamp.
  3. Raise the whole instrument by grasping the top (*not the telescope*) and turn it so that the telescope points in the general direction of the datum point with the plumb bob over the home station. In orienting the Model 1900 instrument on a pier mount, the instrument may be turned in the proper direction by loosening all of the leveling screws.  
(Second and third are not essential to the reading of azimuths, but are provided so that when the adjustment is complete the parts of the instrument will be in the most convenient relative position for operation and reading.)
  4. Level the instrument. See that all the screws have a uniform and firm bearing on the leveling plate; turn the worm box eccentric crank so that the worm is released; set one of the levels exactly over two opposite leveling screws, then turn these two screws either both inward or both outward until the bubble comes in the center, being careful to maintain a firm bearing of the screws on the plate. Then perform the same operation with respect to the other two leveling screws. (The bubble moves in the direction of the left thumb in screwing the leveling screws.) Turn the instrument through 180 degrees and if the bubble does not remain in the center, correct one-half of any variation of either bubble by the ad-

justing screws on the level, the other half by the corresponding leveling screws. Repeat this operation until the bubbles remain in the middle of the tubes for any position of the telescope in azimuth.

5. Focus the eyepiece until every roughness on the cross-wires is seen.

Then turn the telescope on some distant object and focus the objective by means of the focussing knob until the vertical wire remains on the same point of the distant object, when the eye is moved to right and left. If the object appears indistinct when the parallax is removed, refocus the eyepiece and objective (changing a little each time) until the object is seen clearly.

6. Bring the vertical wire of the telescope approximately on the datum point; having set on the azimuth circle and index disc the azimuth of this point; tighten the azimuth clamp, and, using the azimuth slow motion screw, bring the vertical wire exactly on the datum point. Clamp the slow motion screw.

Q. How is back-lash eliminated?

A. Adjust the *worm box adjusting screw* so that there is no play between the worm and the worm gear; adjust the *worm adjusting screw* till there is no longitudinal play of the worm in its box. The disc crank should turn freely—neither too tight nor too loose.

Q. Set up, under direction of the instructor, the azimuth instrument over a given point; level, orient, and focus it.

Q. Direct instrument on five successive points (whose azimuths the instructor has previously determined) and read the instrument.

Q. What precautions must be observed in caring for this instrument?

A. Never touch the lenses with the fingers.

Clean the lenses only with soft linen or "optical paper," making sure there is no grit on the linen or paper.

Do not jar the instrument, as a jar may cause the prisms to slip.

Protect the instrument from dust and moisture.

Do not turn the leveling screws as hard as you can.

## (b) DUTIES IN THE PLOTTING ROOM

### I. MANNING PARTY AND APPARATUS

Q. Name the members of the plotting room manning party.

A. *Plotter*, who plots the course of the target on plotting board and has general charge of work in plotting room.

No. 1, *assistant plotter*. Stationed at gun arm center to assist plotter and to operate the wind component indicator.

No. 2, *primary arm setter*, and

No. 3. *secondary arm setter*, who set off azimuths and ranges sent from the observing stations using either primary arm, secondary arm, or gun arm.

No. 4, *range-board operator*, who operates range board and the atmosphere slide.

No. 5, *deflection-board operator*, who operates deflection board.

No. 6, *range transmitter*, who operates device for transmitting information to the guns.

No. 7, operator for telephone to the emergency station.

(At some batteries a different number of men are used or their duties are changed.)

Q. Name the apparatus used in the plotting room.

A. Plotting board.

Range correction board.

Atmosphere and powder slide rule.

Deflection board.

Wind component-indicator.

Device for measuring travel and plotting set-forward point.

Velocity graphic chart.

Telephones to B', B'', and guns; and mechanical or electrical device for sending information to guns.

Q. What are reference numbers?

A. The numbers of the graduations of some scales of computing and correcting instruments employed in gunnery.

Q. What is the purpose of reference numbers?

A. To avoid the liability to error that comes from the use of "right" and "left" in deflection corrections and of "plus" and "minus" in range corrections.

Q. Do they indicate percentages, miles per hour, yards, etc.?

- A. No.
- Q. What do they indicate?
- A. They indicate settings determined on one instrument (such as the atmosphere and powder slide rule) which are to be applied to the scale of another instrument (such as the range board).
- Q. Why are they called reference numbers?
- A. Because they refer results obtained on one instrument to another instrument by means of numbers that are the same on the scales of both instruments.

## II. THE PLOTTING BOARD

- Q. Point out the following:

Primary station, B' (B prime).  
Secondary station, B' (B second).  
Primary arm.  
Secondary arm.  
Directing point.  
Gun arm.  
Coupler.  
Base line arm (with scales and verniers).  
Base line.  
Azimuth correction scale (used in Case III).  
Tally dials.  
Range correction scale (no longer used, except in setting gun arm for subcaliber practice).  
Azimuth circles (primary, secondary, and gun).  
Subcaliber range scale.  
Diagonal scale of azimuths.

- Q. What is the directing point of a battery?

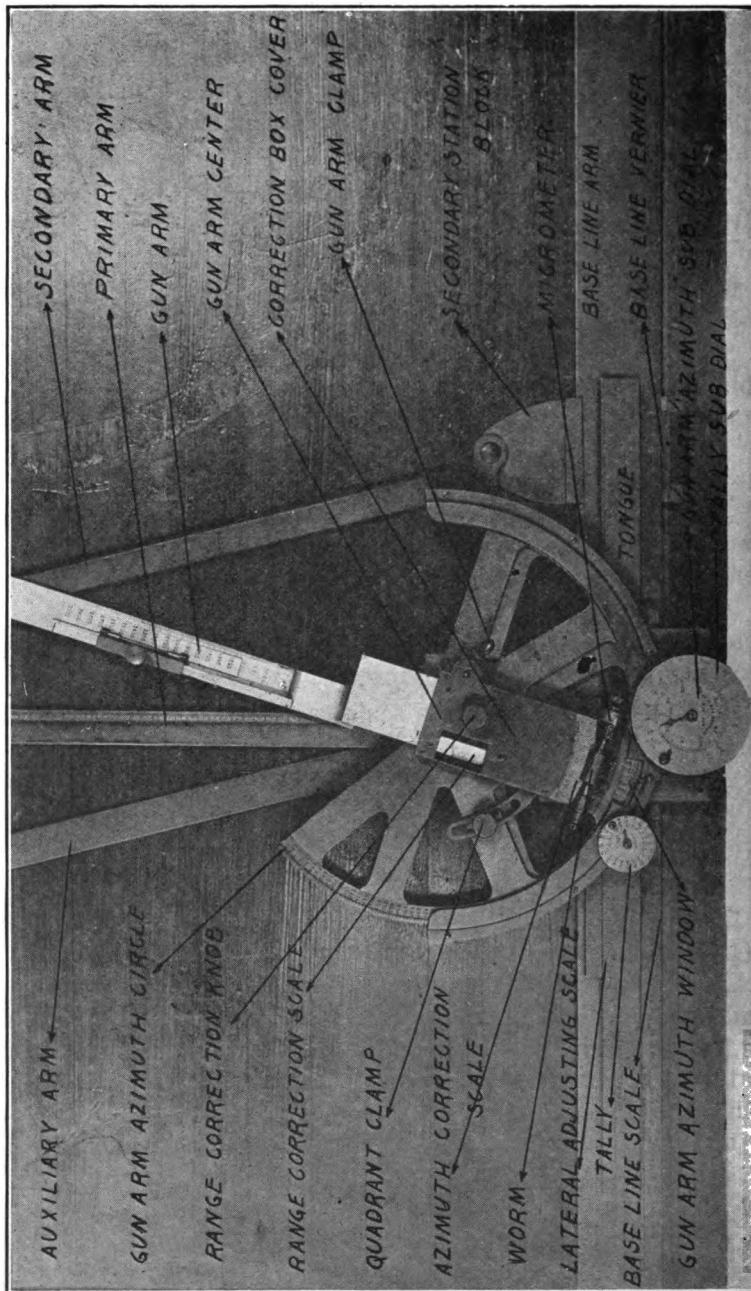
A. A point at or near the battery for which relocation is made in the plotting room. It is the point over which the gun center of the plotting board is adjusted. When the pintle center of a gun is taken as the directing point, such gun is called the directing gun.

- Q. What point at the battery is usually taken as the directing point?

A. The Battery Commander's observing instrument is the directing point when the B.C. station is at the battery.

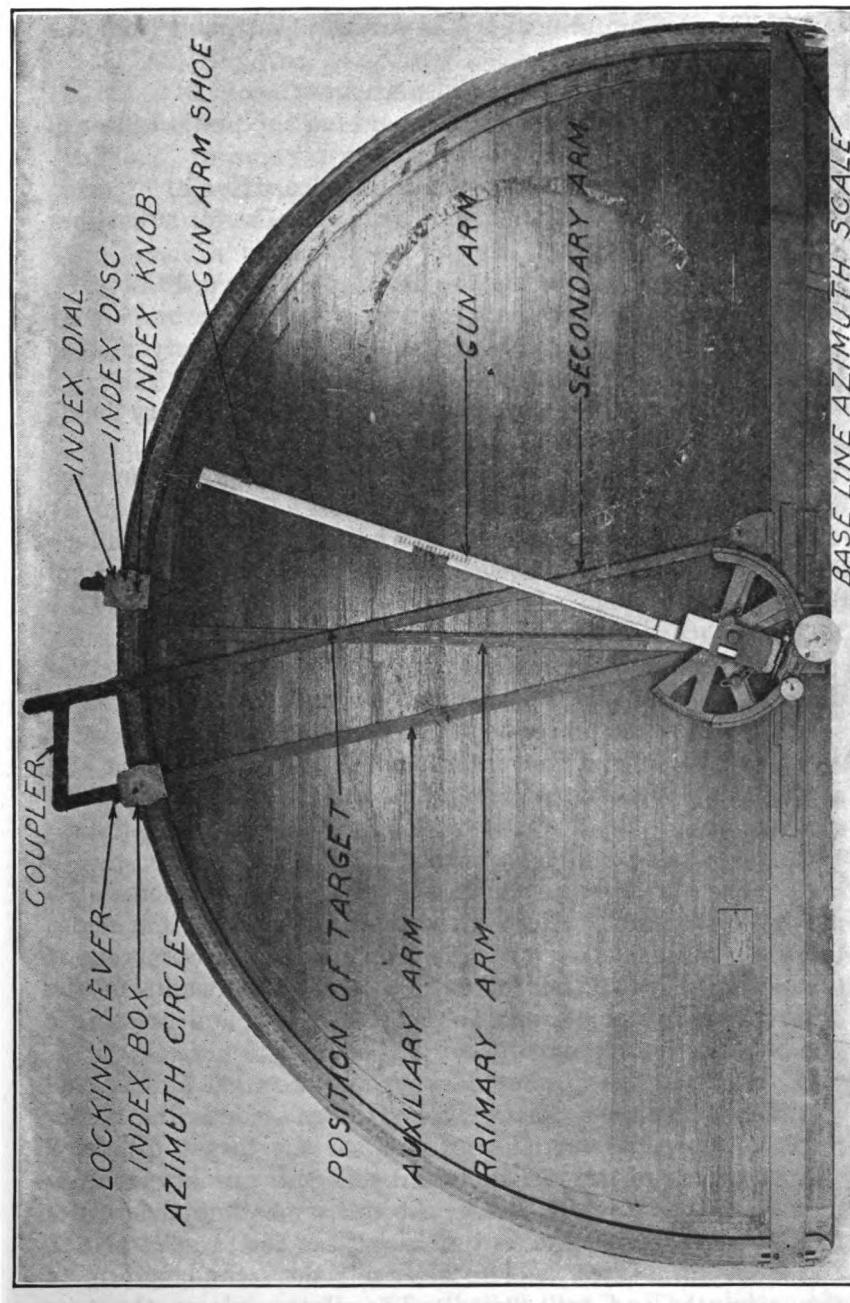
- Q. Why is the B. C. instrument taken as the directing point?

A. So that the azimuth read by the B.C. instrument can be set off on the plotting board by using the gun arm.



Department of Enlisted Specialists, C. A. S.

WHISTLER-MEANS PLOTTING BOARD. (GUN ARM CENTER)



Department of Enlisted Specialists, C. A. S.

WHISTLER-HEARN PLOTTING BOARD

- Q. What is meant by the displacement of any point?  
A. The horizontal distance in yards of that point from the directing point.
- Q. What is meant by gun displacement?  
A. The horizontal distance in yards of the pintle center of a gun from the directing point.
- Q. What is the scale of this plotting board?  
A. 300 yards = 1 inch. (300 ft. = 1 inch, for subcaliber practice.)
- Q. Lay off a distance on the board of \_\_\_\_\_ yards.  
Q. Find the distance between two given points.  
Q. Range and azimuth of a point from primary station being given, locate point on board.  
Q. Range and azimuth of a point from secondary being given, locate the point.  
Q. Find the range and azimuth of a given point from the directing point.  
Q. Azimuth of target from primary 306.11°; secondary 208.11°. Plot the target and find its range and azimuth from directing point.
- Q. What is meant by the observing interval?  
A. The time in seconds between two consecutive observations on a target.  
Q. What is the prescribed observing interval?  
A. 30 seconds. Time interval bells in B', B'', B.C., and at guns ring together and sound on the 28th, 29th, and 30th seconds.
- Q. What is meant by tracking?  
A. The process by which the successive positions of a moving target are plotted on the plotting board. It includes the observations taken every 30 seconds by the observers at the position finding instruments, plotting the results of the observations by points on the plotting board, and drawing a line between these points.
- Q. In what seven different ways may a target be tracked?  
A. 1. *Horizontal Base*.—Every thirty seconds the reader in *B'* (*B prime*) sends the azimuth of the target to No. 2 (primary-arm setter). The latter sets the primary arm to this azimuth and calls "set." At the same time the reader in *B''* (*B second*) telephones the azimuth of the target to No. 3 (secondary-arm setter). The latter sets the secondary arm to this azimuth, and calls "set." The plotter places the targ

accurately at the intersection of the arms and marks on the plotting board the position of the target as thus plotted.

2. *B' (B prime) Auxiliary Base.*—This is like horizontal base. The secondary arm is laid aside. Every thirty seconds the reader in *B' (B prime)* telephones the azimuth of the target to No. 2 (primary-arm setter). The latter sets the primary arm to this azimuth and calls "set." At the same time the reader at the azimuth instrument at the directing point sends the azimuth of the target to No. 3 (secondary-arm setter). The latter sets the gun arm to this azimuth, using the diagonal scale and calls "set." The plotter places the targ accurately at the intersection of the arms and marks on the plotting board the position of the target as thus plotted.

3. *B'' (B second) Auxiliary Base.*—The primary arm is laid aside. Every thirty seconds the reader in *B'' (B second)* telephones the azimuth of the target to No. 3 (secondary-arm setter). The latter sets the secondary arm to this azimuth and calls "set." At the same time the reader at the azimuth instrument at the directing point sends the azimuth of the target to No. 2 (primary-arm setter). The latter sets the gun arm to this azimuth, using the diagonal scale, and calls "set." The plotter places the targ accurately at the intersection of the arms and marks on the plotting board the position of the target as thus plotted.

4. *B' (B prime) Vertical Base.*—The range officer throws the switches so as to bring both arm-setters' telephones in multiple with the reader's telephone in *B'*. The secondary arm is laid aside. The reader in *B'* sends the range and azimuth of the target every thirty seconds. No. 2 (primary-arm setter) sets the primary arm to the azimuth. No. 3 remembers the range and calls it to the plotter as soon as No. 2 has called "set." The plotter places the targ against the primary arm at the range called by No. 3, and marks on the plotting board the position of the target as thus plotted.

5. *B'' (B second) Vertical Base.*—The range officer throws the switches so as to bring both arm setters' telephones in multiple with the reader's telephone in *B''*. The reader in *B''* sends the range and azimuth of the target every thirty seconds. The primary arm is laid aside. No. 3 (secondary-arm setter) sets the secondary arm to the azimuth. No. 2 (primary-arm setter) remembers the range and calls it to the plotter as soon as No. 3 has called "set." The plotter places the targ against the secondary arm at the range called by

No. 2 and marks on the plotting board the position of the target as thus plotted.

6. *Coincidence System*.—Only one arm is used. If the coincidence instrument is close to the battery, the gun arm is used. The description will be given for this condition. The primary and secondary arms are laid aside. Every thirty seconds the azimuth of the target is sent from the azimuth instrument at the directing point to No. 2 (primary-arm setter). The latter sets the gun arm to this azimuth, using the diagonal scale and calls "set." At the same time the range of the target is sent to No. 3. The latter remembers this range and calls it to the plotter as soon as No. 2 has called "set." The plotter places the targ against the gun arm at the range called by No. 3 and marks on the plotting board the position of the target as thus plotted.

The *coincidence system* is similar, in the method of operation, to the *vertical base systems*.

7. *Emergency System*.—As provided for the particular battery.

Q. What is the *predicted point*.

A. It is the place where we expect the target to be on the next bell.

Q. What is the *set-forward point*.

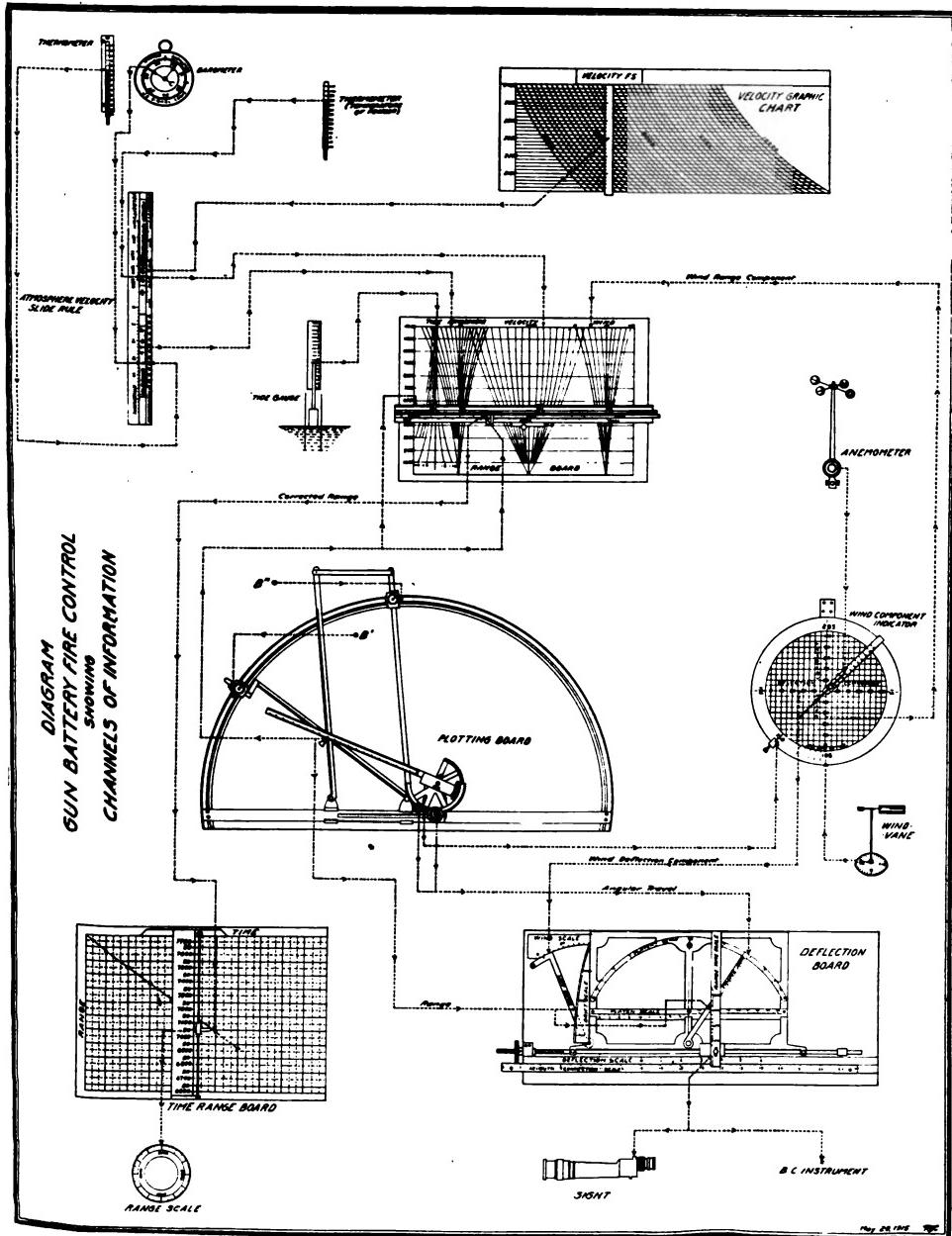
A. It is the place where we expect the target to be at the end of the time of flight: that is, the place where the target and projectile will arrive at the same time.

Q. What does the plotter do after two or more positions of the target have been plotted?

A. He commands or signals "Clear." The arms are moved out of the way. He estimates the direction in which the target is going and locates the set-forward point on the expected course of the target.

Q. How does he plot the set-forward point?

A. He uses a device prescribed by the battery commander. He plots the set-forward point for firing on the next bell. That is, he measures how far the target traveled during the last thirty seconds; he then measures from the last plotted point (and along the expected course of the target), a distance which is equal to the travel during the last thirty seconds plus the travel to be expected during the time of flight. He plots the set-forward point so determined. Therefore, if the gun is fired on the next bell, the set-forward point is where the target is expected to be when the projectile strikes. We



must endeavor to make the projectile strike at this range and in this direction.

Q. What does the plotter do as soon as the set-forward point is plotted?

A. He brings the gun arm up to the set-forward point and reads the actual range to No. 4 (range correction board operator), being sure that the range correction scale is always set and clamped at the reference number 2000 which is normal.

Q. What is meant by the *angular travel* of the target?

A. It means the change in azimuth (or direction) of the target during a given time—either during the observing interval or during the time of flight. If we determine what the angular travel was during the last thirty seconds, the deflection board will give the correction for the angular travel during the time of flight.

Q. How is the angular travel during the last thirty seconds measured?

A. The plotter brings the gun arm up to the last plotted point. No. 1 (assistant plotter) sets the tally dial to 15 (normal) and the subdial to 0 (normal), and then makes sure that the dials are not moved before the next reading. When the position of the target is plotted thirty seconds later, the gun arm is brought to this new point. The angular travel during thirty seconds (between the plotted points) will be indicated as a reference number on the tally dial and the subdial.

No. 1 (assistant plotter) reads the angular travel reference number to No. 5 (deflection board operator). No. 1 (assistant plotter) then sets the tally dial and subdial to normal again, to get the angular travel during the next thirty seconds. The plotter does not move the gun arm until the tally dial and the subdial are set at normal.

Note:—The following alternative methods are permissible:

1. The angular travel may be measured between set-forward points, instead of between plotted points.

2. The plotting board need not be used for measuring the angular travel. Instead, the change in azimuth of the target during thirty seconds (for use on the deflection board) may be measured by an observing instrument near the battery.

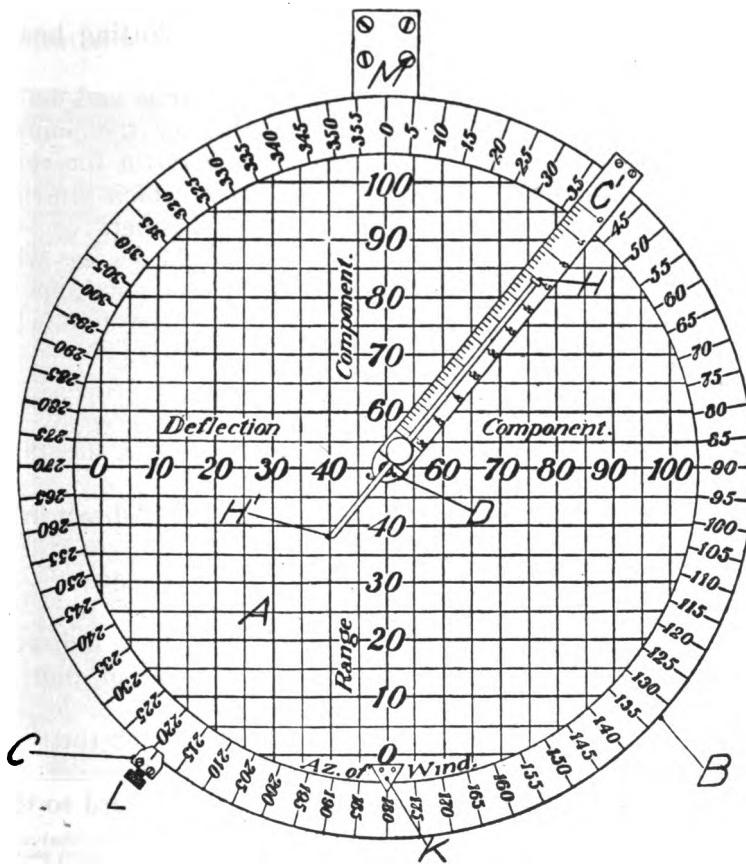
### III. DAILY MESSAGE AND WIND COMPONENT INDICATOR

Q. What is the daily message, or as sometimes called, the "meteorological message"?

A. It is a message from the meteorological station, usually transmitted through the F.C. (fire commander) station. It contains information for correcting the range, deflection, or azimuth to be used at the guns before firing.

Q. How often is the daily message received?

A. At least every half hour.



Q. What information does it contain?

- A. 1. Height of tide;  
2. The azimuth in degrees from which the wind is blowing;  
3. Wind velocity in miles per hour;  
4. Atmosphere reference number. (Usually the thermometer and barometer readings, from which the atmosphere reference number was determined, are also sent.)

Q. What use is made of the wind azimuth and velocity?

A. They are used on the wind component indicator.

Q. Tell how to use the wind component indicator.

A. (See illustration of Wind Component Indicator.) Set the pointer (H) to the wind velocity, and by turning the movable azimuth ring (B) bring the wind azimuth to the pointer (K). Set the target arm (C') to the azimuth of the target, as indicated by the gun arm of the plotting board, using the index (C).

The reference numbers to be used on the range and deflection boards are indicated by the end (H') of the pointer. Always read the figures which run up and down for range board wind reference number, and the figures which run right and left for deflection board wind reference number.

Q. If the temperature of the powder was 68 degrees when trial shots were fired, and the velocity determined from the trial shots was 2235 f.s., what velocity should be used when the same powder has a temperature of 75 degrees?

#### IV. THE RANGE CORRECTION BOARD

Q. What information is necessary to operate the range correction board, and where is it obtained?

A. 1. *Height of tide*: from daily message or direct from F.C. station.

2. *Atmosphere reference number*: from daily message.

3. *Muzzle velocity*: from battery commander.

4. *Wind reference number*: from wind component indicator.

5. *Range to set-forward point*: from gun arm of plotting board.

Q. How do you keep track of this information on the range correction board?

A. By sliding the markers at the top of the board so that they point to the numbers of the curves to be used.

Q. Explain the complete operation of the range board.

A. 1. Set each *marker* (6) at its proper correction curve.

2. Set each *pointer* (13) at normal (red line).

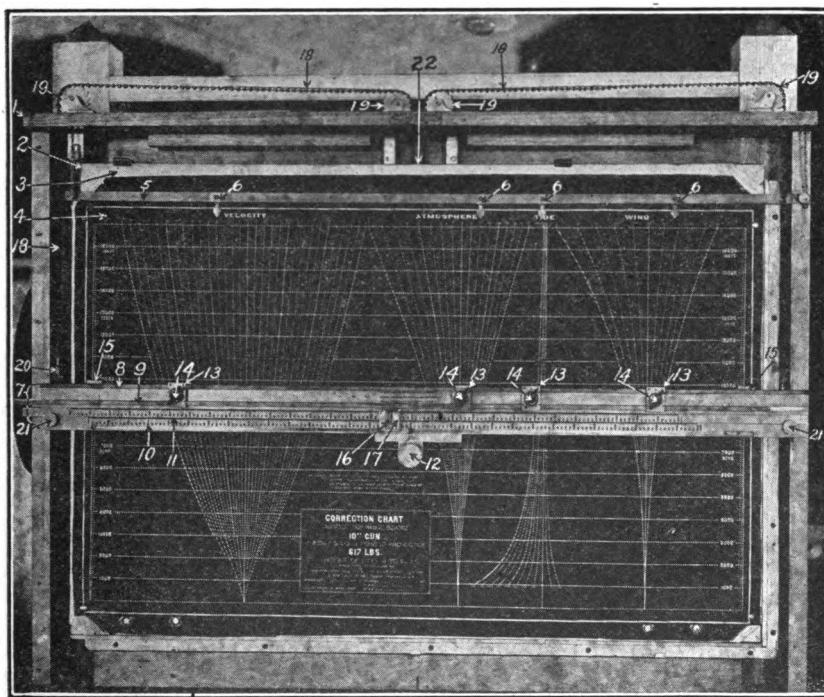
3. Make the *fixed* (10) and *movable* (11) *range scales* coincide.

4. Set the *movable index* (16) at the actual range of the set-forward point, on the *fixed range scale*.

5. Set the *ruler* (7) at the actual range of the set-forward point.

6. Make the correction for atmosphere as follows;

- a. Turn the *clamp* (14) to *M*;
- b. Turn the *knob* (12) until the pointer indicates the proper correction curve;
- c. Turn the *clamp* (14) to *S*.
7. Make the correction for velocity in a manner similar to that indicated in 6 above for atmosphere.
8. Make the correction for tide in a manner similar to that indicated in 6 above for atmosphere.



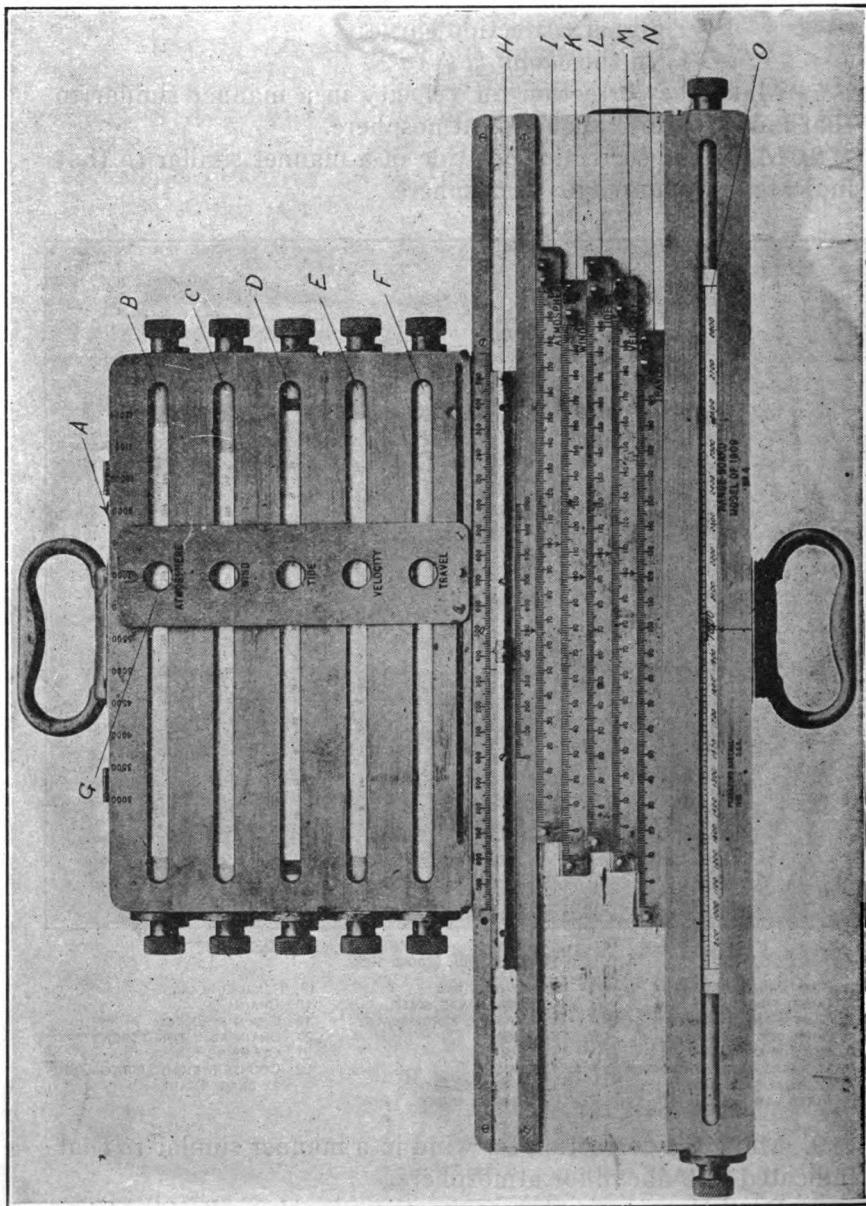
RANGE BOARD, MODEL 1905

- |                                |                         |   |
|--------------------------------|-------------------------|---|
| 1. BOX (MAHOGANY).             | 9. MOBILE BAR.          | 17. READING GLASS.                            |
| 2. CHART FRAME.                | 10. FIXED RANGE SCALE.  | 18. CHAIN.                                    |
| 3. CANVAS CHART MOUNT.         | 11. MOBILE RANGE SCALE. | 19. CHAIN SPROCKET.                           |
| 4. CORRECTION CHART.           | 12. KNOB.               | 20. CHAIN ADJUSTING SCREW.                    |
| 5. BAR FOR MARKERS.            | 13. POINTERS.           | 21. CLAMPING SCREW.                           |
| 6. MARKERS (CURVE INDICATORS). | 14. CLAMP.              | 22. COUNTERWEIGHT (CONCEALED BY CHART FRAME). |
| 7. CORRECTION RULER.           | 15. FIXED INDEXES.      |   |
| 8. FIXED BAR.                  | 16. MOBILE INDEX.       |   |

9. Make the correction for wind in a manner similar to that indicated in 6 above for atmosphere.

10. Read the corrected range on the *movable scale* (11) at the index under the reading glass.

- Q. What is done with the corrected range?  
 A. It is sent to the time-range board.



Department of Enlisted Specialists, C. A. S. RANGE CORRECTION BOARD. (ISSUED TO A FEW 8-INCH BATTERIES)

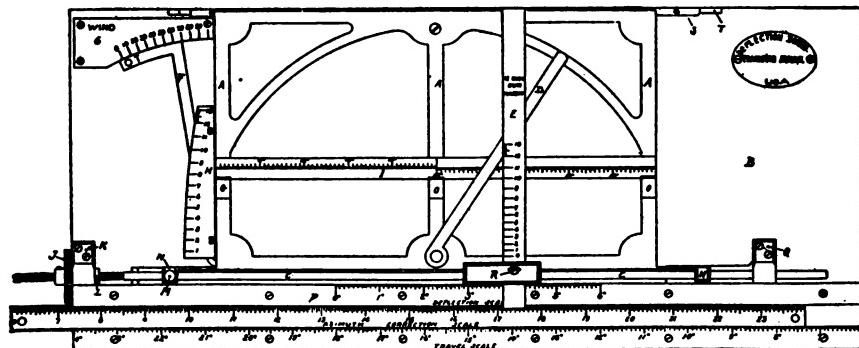
## V. THE DEFLECTION BOARD

**NOTE:**—There are two slightly different types of deflection boards in service. Both are illustrated. The later type differs from the earlier in the following respects:

(1) The travel arm is serrated on the edge which is not used, to avoid its use through mistake. The travel arm on all boards should be so prepared.

(2) There is a pointer pointing downward, on the deflection scale just below the 3 mark, for use in setting the azimuth correction scale.

(3) The T-square knob (*R*) is threaded, and the T-square can be clamped to the rod (*C*) if desired.



DEFLECTION BOARD (OLD MODEL)

(4) There is no travel scale at the bottom of the board.

Q. Point out the following:

Platen.

Platen scale (30-second).

(NOTE:—Platen scale, 15-second, is not used.)

Travel arm.

T-square scale (service and subcaliber).

Leaf range scale (service and subcaliber).

Wind arm.

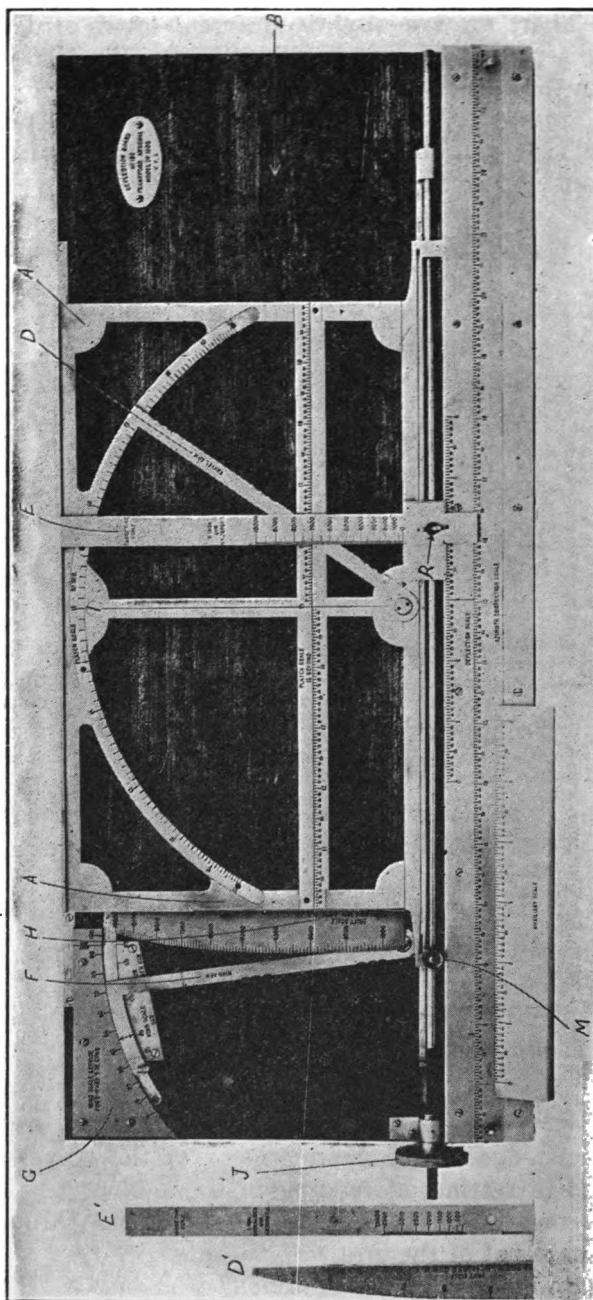
Wind arc (service and subcaliber).

Q. Which edge of the wind arm or of the travel arm is always used in setting off readings?

A. The one which if prolonged would pass through the center of the pivot of the arm.

Q. What is meant by the *deflection*?

A. It is the difference between the azimuth of the target



DEFLECTION BOARD. (NEW MODEL)  
Department of Ordnance Specialists, C. A. S.

and the azimuth at which the bore is pointed. Deflection must be used so that when the piece is fired with the line of sight on the azimuth of the target, the shot will strike on the azimuth at which the target will be at the end of the time of flight.

Q. What causes affect the value of the deflection correction?

A. Lateral effect of the wind, drift, and angular travel of the target during the time of flight, affect the total deflection correction.

Q. What information is necessary in order to operate the deflection board?

A. 1. The *wind reference number* obtained from the wind component indicator.

2. *The actual range to the target*, obtained from the gun arm of the plotting board.

3. The *angular travel* of the target, during 30 seconds, obtained at the plotting board and called off by No. 1 (assistant plotter) using the tally and hundredths dials.

Q. Explain how to operate the board to obtain the deflection for the sight.

A. (See illustration of the deflection board.)

1. Set the wind arm (F) to the proper reference number, as indicated by the wind component indicator.

2. Set the platen (A) so that the point of the drift curve corresponding to the actual range, obtained from the gun arm of the plotting board, will be accurately over the right hand edge of the wind arm.

3. Using the circular, 30 second, platen scale, set the outer end of the travel arm (D) for the travel reference number read from the tally dials of the plotting board.

4. Set the T-square (E) so that the point of its scale corresponding to the actual range, obtained from the gun arm of the plotting board, will be accurately over the edge of the travel arm;—right hand for old model board, and left hand for new model.

The beveled edge of the T-square (E) then indicates on the deflection scale the deflection to be used on the sight with Case I or II.

Q. How is the deflection board used in Case III?

A. Different methods are used at different batteries.

The set-forward point having been located on the plotting board, before its azimuth is sent to the guns it must be cor-

rected for wind and drift. One method of using the deflection board for the purpose is as follows:

1. Set the 15 graduation of the azimuth correction scale at normal of the deflection scale (unless an arbitrary correction is ordered).
2. Set the wind arm (F) to the proper reference number.
3. Set the platen (A) so that the point of the drift curve corresponding to the range will be accurately over the right hand edge of the wind arm.
4. Set the travel arm out of the way, and set the T-square on the "median line" of the platen.

The beveled edge of the T-square (E) then indicates on the azimuth correction scale the reference number to be set on the azimuth correction scale *on the rear part of the gun arm of the plotting board*.

5. On the plotting board bring the gun arm up to the set-forward point and read the azimuth on the gun arm azimuth circle and subdial.

6. The gun is fired on the third stroke of the next bell.

NOTE.—If it is desired to fire on observation, the predicted point also is plotted and its azimuth read from the diagonal scale on the plotting board. This azimuth is set on the B.C. instrument and the guns fired when the target crosses the vertical wire.

Q. How are the battery commander's arbitrary corrections applied to the deflection board?

- A. Different methods are used at different batteries.

#### *First Method: Using Auxiliary Scale*

1. The battery commander follows the target with the cross wire of a telescopic sight or the pointer of a 1910 azimuth instrument. As soon as the splash appears, he stops his instrument and if the splash is not at the target he moves the vertical wire or pointer to bisect the splash. The reading of the cross wire or pointer is then sent to the deflection board.

2. The deflection board is operated in the usual manner. The  $3^\circ$  reading of the auxiliary scale is then placed opposite the beveled edge of the T-square. As soon as the battery commander's reading of the splash is received, the T-square is moved to this reading on the auxiliary scale.

3. The beveled edge of the T-square then indicates on the deflection scale the corrected deflection to be used on the sight and is sent to the guns.

*Second Method: Using Azimuth Correction Scale*

The method to be described requires that the numbers 1, 2, 3, 4, and 5 be placed above (or below) the numbers 13, 14, 15, 16, and 17 respectively of the (sliding) azimuth correction scale. This scale is then set with the 3 graduation opposite the 3 on the deflection scale and used in place of the deflection scale (a strip of paper is usually pasted over the deflection scale so it cannot be used through error).

1. The board is operated in the usual manner and the deflection is read from the sliding scale and sent to the B.C. and the guns.

The battery commander follows the target with the vertical wire of a telescopic sight or pointer of 1910 azimuth instrument set at the same deflection as is being used at the guns. As soon as the splash appears he stops his instrument, and if the splash is not at the target he moves the vertical wire or pointer to bisect the splash. This gives the deflection which should be used for the next shot and the B.C. can check his work by requiring the gun pointer who fired the shot to call out to him what correction he would use for the next shot. It is now necessary to apply this correction to the deflection board as follows:

2. With the platen and T-square held in the same position as when the last deflection was sent to the guns, move the sliding scale until the beveled edge of the T-square reads the corrected deflection sent by the battery commander. This corrected deflection is at once sent to the guns for Case II. At the same time the new azimuth correction can be applied on the azimuth correction scale on the gun arm for Case III.

3. Continue the operation of the board as wind, range, and travel change, reading deflections from the sliding scale, and taking care to see that the sliding scale does not move unless further arbitrary correction is ordered by the battery commander. The position of the sliding scale after an arbitrary correction should be marked by a pencil line at one end of the scale.

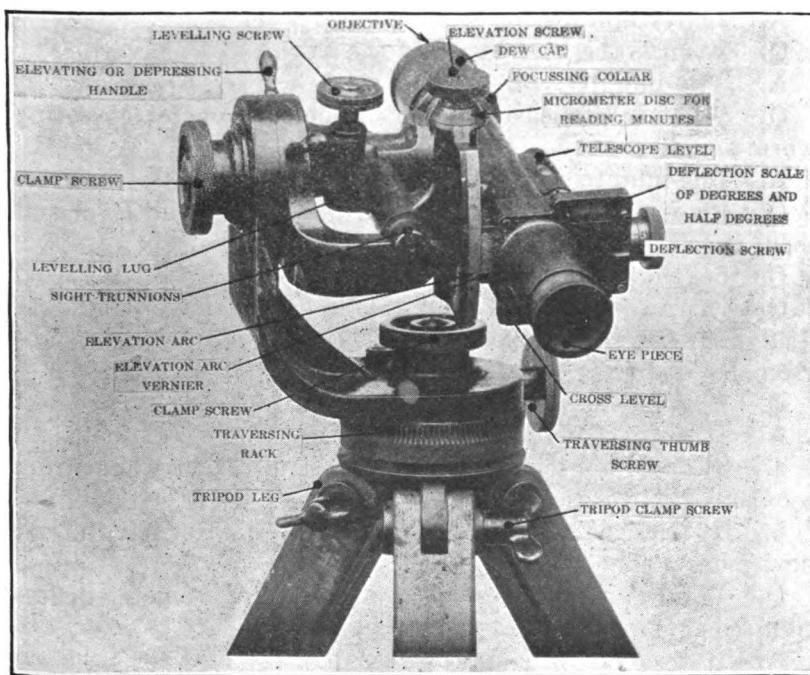
### (c) AIMING AND LAYING OF GUNS

- Q. What kind of angles are used in aiming and laying guns?
- A. Horizontal and vertical angles.
- Q. When are horizontal angles used?
- A. In giving direction to the gun, either by the sight or the azimuth scale.
- Q. When are vertical angles used?
- A. In giving the piece the proper elevation so that the projectiles will range to the target.
- Q. What is Case I?
- A. When direction and elevation are both given by the sight.
- Q. Set gun in Case I. Deflection 2.35, elevation  $5^{\circ} 36'$ .
- Q. Point out on the gun carriage: the service range scale; the subcaliber range scale; the elevation scale.
- Q. Set the service range scale for 5445 yards; set the subcaliber scale for 3025 yards; set the elevation scale to read plus 5 degrees.
- Q. What is Case II?
- A. When direction is given by sight and the elevation is given by the range scale.
- Q. Set gun in Case II. Range 7562 yards, deflection 3.10.
- Q. If shot falls to right, do you increase or decrease setting of sight?
- A. You decrease it.
- Q. If shot falls to left, do you increase or decrease setting of sight?
- A. You increase it.
- NOTE.—In other words: to fire right, add; and to fire left, subtract.
- Q. What is Case III?
- A. When direction is given by the azimuth circle and elevation is given by the range scale.
- Q. Given a range and azimuth, set them.
- Q. If Case III is ordered and you get a range and azimuth, what time should the piece be fired on that data?
- A. On the next bell, unless otherwise ordered.
- Q. What care must be taken in seating a sight?

A. Do not remove a sight from its case until on the sighting platform. Remove the model 1898 MII sight by the strap. See that there is no dirt, grit, nor paint on the bearing surfaces between the sight and cradle or bracket. Always handle a telescopic sight with the utmost care, as it is a delicate instrument.

#### TELESCOPIC SIGHT, MODEL 1898 MII

Q. Name the principal parts of the telescopic sight, model of 1898 MII.



Department of Enlisted Specialists, C. A. S.

TELESCOPIC SIGHT, MODEL 1898 MII MOUNTED ON HAGOOD TRIPOD MOUNT

A. Sight trunnions, leveling lug, telescope level, eye piece, focussing collar, dew cap, micrometer deflection screw, micrometer elevating worm spindle, cross level, outside deflection scale, vernier scale, line of collimation.

Q. How is sight seated on gun for Case I?

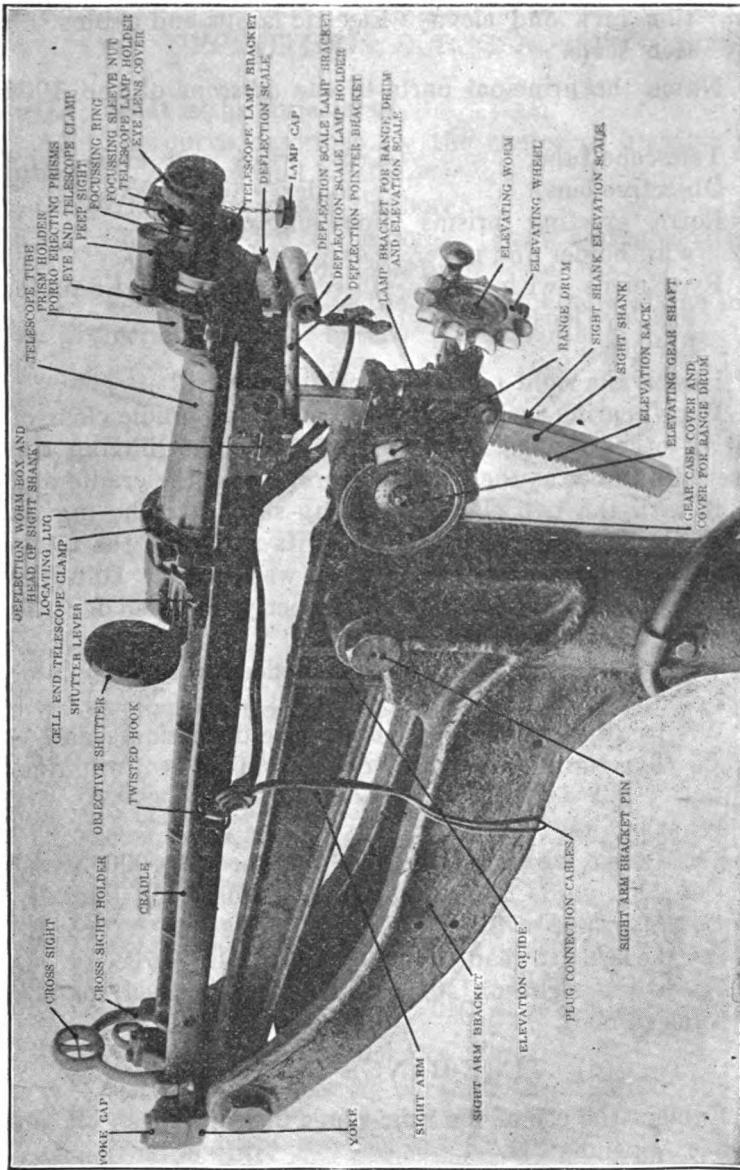
A. Remove sight, place it carefully in its seat on sight bracket on gun trunnion. Level cross-level with leveling lug. When telescope level reads zero the gun should show zero elevation.

- Q. Where is sight placed in Case I, in Case II, in Case III?
- A. In Case I it is placed on sight bracket on right trunnion. In Case II it is placed on sight standard. In Case III it is not used.
- Q. What is the least reading of the outside deflection scale?
- A. Fifty one-hundredths of a degree.
- Q. What is the least reading of micrometer deflection scale and the inside deflection scale?
- A. Five one-hundredths of a degree.
- Q. Set the scale to read the following: 3.45, 2.70.
- Q. What is the least reading of the elevation scale?
- A. Thirty minutes.
- Q. What is the least count of the elevation scale vernier?
- A. Two minutes.
- Q. What is the least reading of the micrometer elevating worm spindle?
- A. One minute.
- Q. Place the sight on Hagood tripod mount and level and focus it.
- Q. Set off elevation of  $5^{\circ} 23'$ ; of  $7^{\circ} 53'$ .
- Q. Instructor to set off two readings and have candidate read elevation; first by using vernier, second by using micrometer elevating screw worm spindle.
- Q. What is the telescopic sight used for?
- A. It is used for the following purposes:
- By gun pointers to give the gun direction when firing by Cases I and II.
  - By observers to tell how far to the right or left (lateral deviation) a shot falls.
- Q. What is the smallest division on the micrometer deflection scale?
- A. It is called "a point" and is equal to:
- 3 Minutes.
  - .05 Degree.
  - 1 Mil or one one-thousandths of the range.

#### TELESCOPIC SIGHT, MODEL 1904\*

- Q. Name the principal parts of the telescopic sight, model of 1904. (See illustration on page 61.)
- A. Telescope proper. Deflection worm and worm Cradle and its fulcrum. box.

\* The 2-inch telescopic sight, model 1906, is similar to the model of 1904, except in its size and a few minor particulars.



Department of Explosive Specialists, C. A. S.

3-INCH TELESCOPIC SIGHT, M. 1904

Telescope clamps.	Deflection scale and pointer.
Open sights.	Elevating worm and wheel.
Sight shank, with elevation rack and elevation scale.	Range drum and cover. Electric lamps and cables.

Q. Name the principal parts of the *telescope* of the 1904 sight.

- A. Telescope tube. Cross wires and cross wire holder.
- Objective lens.
- Porro erecting prisms Focussing ring.
- with holder and cover. Lamp holders.
- Eye piece with field Objective shutter and handle, lens, eye lens and amber glass.

Q. How is the sight placed in position for use?

A. Wipe bearing surfaces between sight and cradle clear of all grit or other foreign matter; place the sight (having the same serial number as the bracket) carefully in the cradle and secure it with the two clamps, making sure that the lug on the forward clamp fits accurately into its recess on the telescope body. Set the clamping screws well home. Run the sight cradle up or down until it is properly adjusted for the range at which the sight is to be used.

Q. What is the least reading of the deflection scale?\*

A. Five one-hundredths of a degree.

Q. What is the smallest division on the deflection scale?

A. .05 (five hundredths) of a degree. This is 3 minutes, or 1 mil.

Q. What is a mil?

A. That angle which will include one yard at 1000 yards, 2 yards at 2000 yards, 3 yards at 3000 yards, etc., laterally on the target or field of fire.

Q. Set the scale to read the following: 3.45; 2.70.

Q. Focus the sight on some object as described for the azimuth instrument.

#### (d) TIME-RANGE BOARD

Q. Explain the use of the time-range board.

A. See Appendix "H."

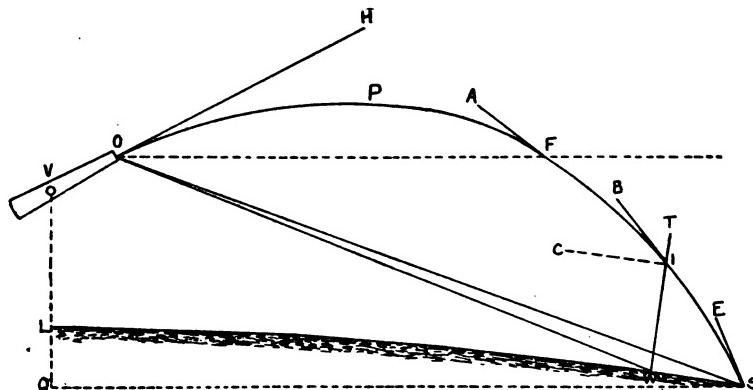
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\* The graduations on the range drum and on the sight shank will not be used (see Ordnance pamphlet No. 1955, revised April 2, 1912).

(e) DEFINITIONS, D. R. C. A., 1914\*

Q. What is the trajectory?

- A. The curve described by the center of gravity of the projectile. (Draw and label it.)
- Q. What is the axis of the bore?
- A. The center line of the bore. (Draw and label it.)
- Q. What is the line of departure?
- A. The prolongation of the axis of the bore at the instant the projectile leaves the bore. (Draw and label it.)



OPS Trajectory.

F Point of fall.

I Point of impact.

S Point of splash.

W Center of target.

LV Height of site.

OH Line of departure.

OW Line of direction.

AF Line of fall.

BI Line of impact.

OS Chord of the trajectory.

OS Range of shot.

TW Target.

FOS Angle of depression.

ESQ Angle of splash,—danger angle.

HOS Angle of departure.

HOF Quadrant angle of departure.

AFO Angle of fall (Range Table) for horizontal range OF.

BIT Angle of impact.

BIC Angle of incidence.

Q. What is the line of sight?

- A. A straight line passing through the sights of the piece and the target. (Draw and label it.)

Q. What is drift?

- A. It is the divergence from the plane of departure of the projectile under the influence of the rotation of the projectile

\* See Appendix "B."

and the resistance of the air. In our service it is always to the right. (Draw and label it.)

Q. What is muzzle velocity?

A. It is the velocity of the projectile as it leaves the muzzle, measured in feet per second.

Q. What is jump?

A. It is the increase or decrease of the elevation at the instant the projectile leaves the gun. (Draw and label it.)

Q. What is quadrant elevation?

A. The angle between the horizontal and the axis of the bore when the piece is pointed. (Draw and label it.)

Q. What is the quadrant angle of departure?

A. The angle between the horizontal and the axis of the bore at the instant of firing. (Draw and label it.)

Q. What is sight elevation?

A. The angle between the line of sight and the axis of the bore. (Draw and label it.)

Q. What is the danger angle, or angle of splash?

A. It is the angle that the tangent to the trajectory at the point of splash makes with the plane containing the point of splash and parallel to the horizontal plane through the muzzle of the piece in the firing position. (Draw and label it.)

Q. How is the angle of fall expressed?

A. Either in degrees and minutes, as  $5^{\circ} 16'$ , or as 1 on 17.

Q. What does 1 on 17 mean?

A. That the projectile falls vertically 1 yard in going 17 yards on the horizontal.

Q. What is time of flight?

A. The time required for the projectile to travel from the gun to the point of impact.

## (f) GENERAL FEATURES OF WARSHIPS

Q. How may warships be classified?

A. The general broad classification which is at present accepted throughout the world is:

(1) Armored ships, including:

- (a) Dreadnoughts (16,000 tons and over).
- (b) Battle-cruisers (dreadnoughts) (17,000 tons and over).
- (c) Battleships (pre-dreadnoughts) (11,000 to 16,000 tons).
- (d) Armored cruisers (9000 to 15,000 tons).
- (e) Monitors (3000 to 8000 tons).

(2) Unarmored ships, including:

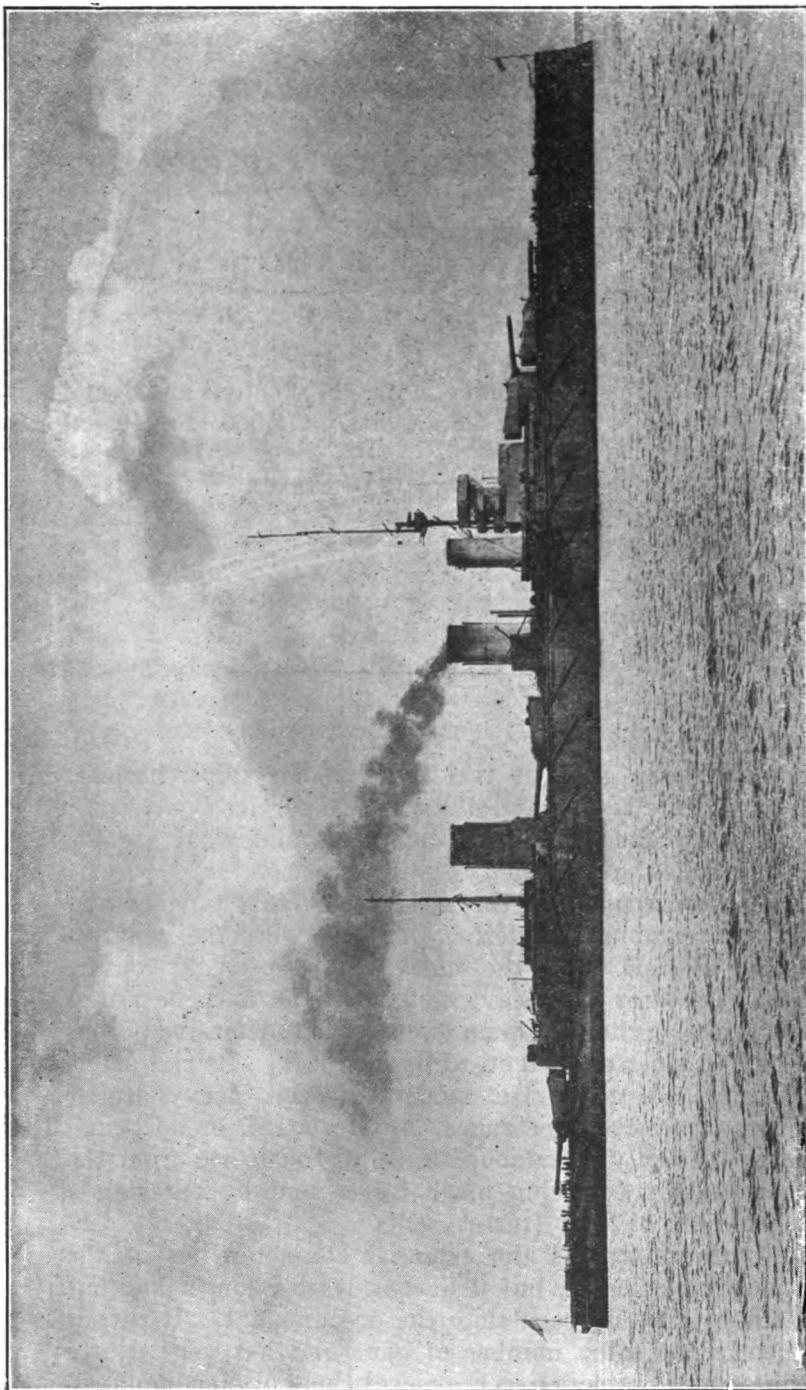
- (a) Protected cruisers.
- (b) Scout cruisers.
- (c) Gunboats.
- (d) Torpedoboat destroyers.
- (e) Torpedoboats.
- (f) Submarines.

(3) Auxiliaries, such as fuel ships, repair ships, hospital ships, tugs, mine layers, and other special service boats.

Q. What is the purpose of each class and what are the characteristic features of each?

A. The *dreadnought* is the most formidable type of war vessel, and combines powerful weapons with the greatest protection possible under the limitations imposed by floating warfare. To carry the heavy guns and the massive armor necessary to give the maximum offensive and defensive power, speed has, to a certain extent, to be sacrificed. Its characteristic features are great size, moderate speed, heavy armor, heavy guns, massive appearance, low freeboard, broad beam, and large turrets. Dreadnoughts are distinguished from the older battleships by being much larger and by carrying a greater number of large (turret) guns.

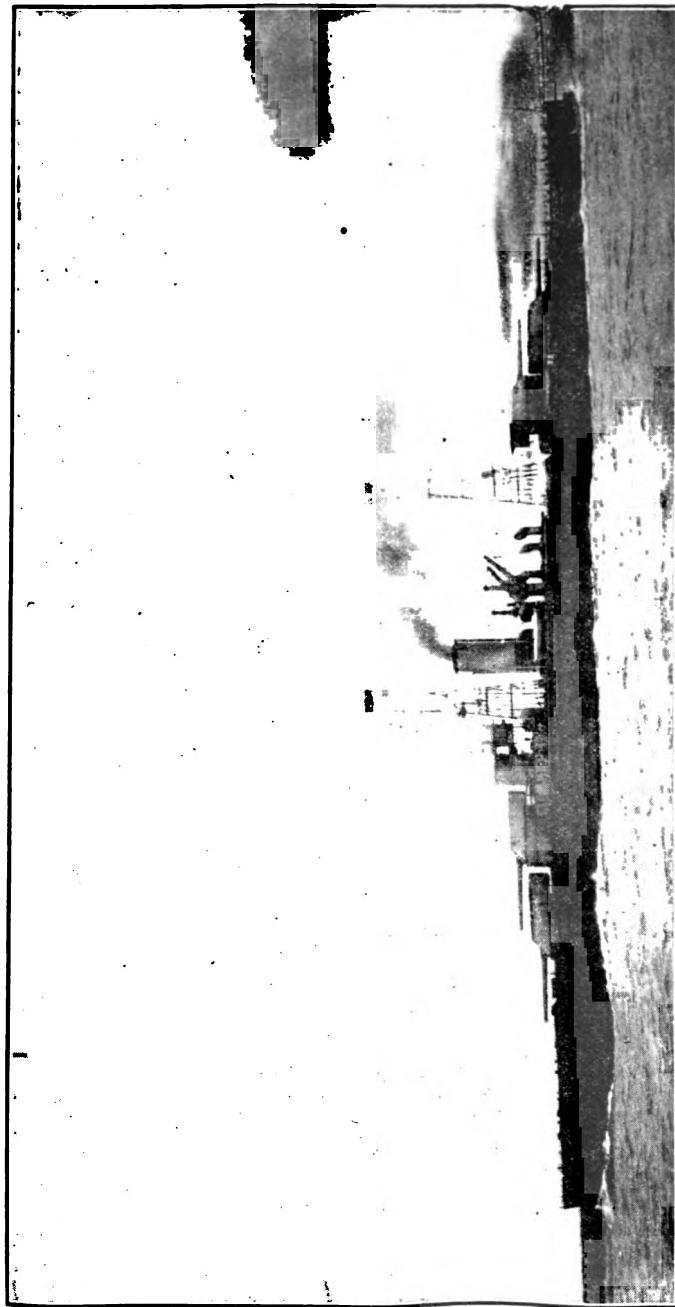
The *battle-cruiser* has the essential characteristics of the dreadnought battleship, but it is considerably longer and has considerably greater speed than the dreadnought. It carries very nearly the same number of guns and has very nearly the same armor protection as the recent types of dreadnoughts.



Photograph by Stephen Orton, Scutelles.

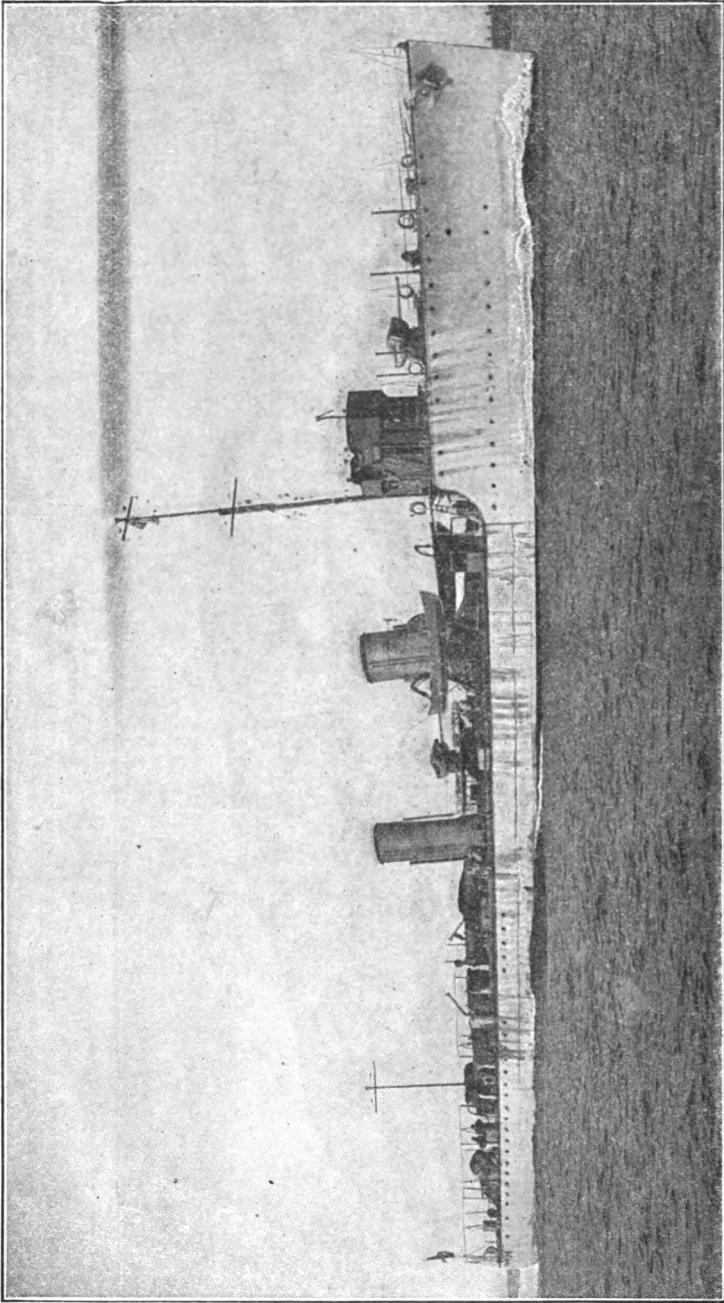
H. M. BATTLE CRUISER "QUEEN MARY"

DISPLACEMENT, 27,000 TONS. BEAM, 38 FEET. DRAUGHT, 20 FEET. LENGTH OVER ALL, 606 FEET. ARMAMENT: 8 13.5-INCH GUNS; 16 4-INCH GUNS; 3 21-INCH TORPEDO TUBES. ARMOR: BELT, 9 INCHES (ARMORSHIP), 4 INCHES (ENDS); TURRETS, 9 INCHES; DECK, 3 INCHES. SPEED: DESIGNED 28 KNOTS; PROBABLE 34. PARSONS TURBINE.—LE YACHT. (PARIS) (68)



Photograph by Boston Photo News Co.

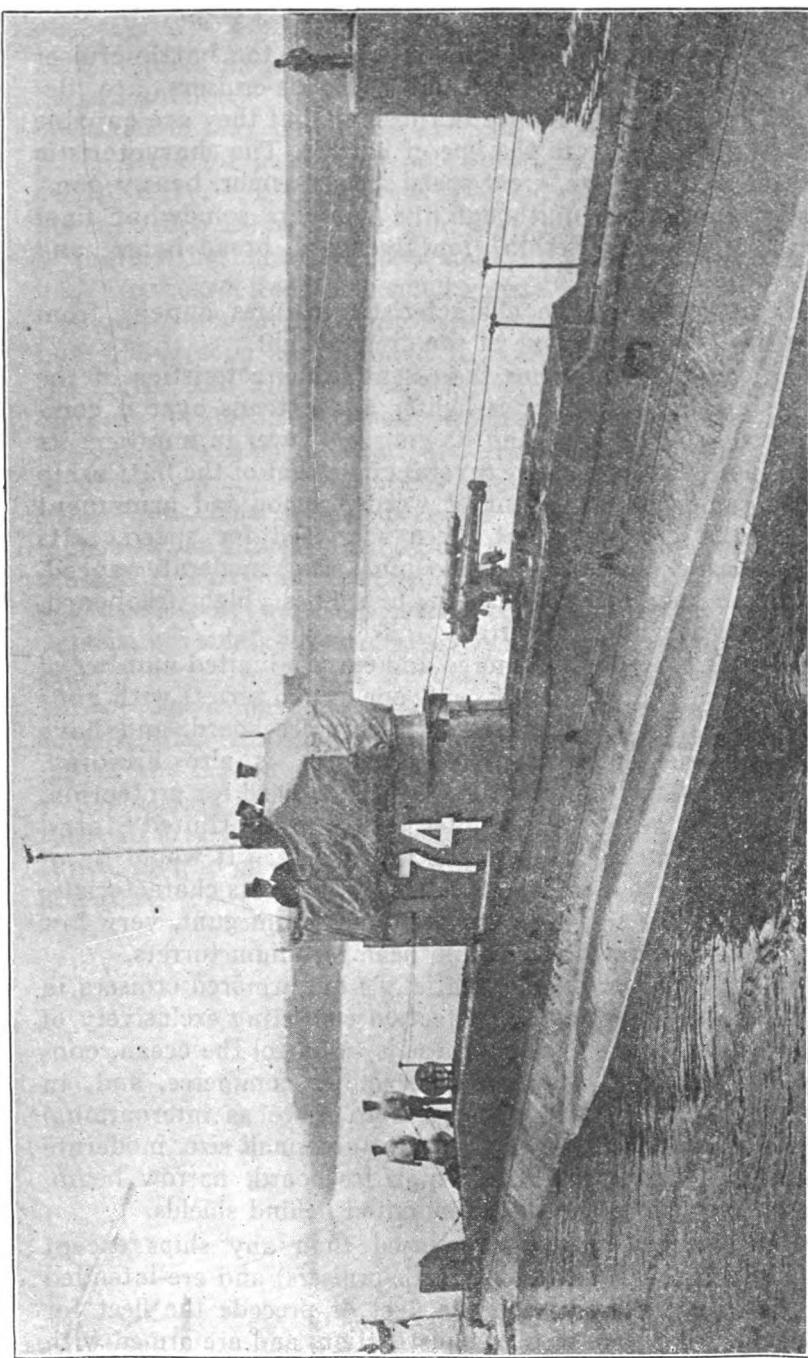
U. S. BATTLESHIP "NEVADA"  
COMPLETED JANUARY, 1915. FULL LOAD DISPLACEMENT, 28,400 TONS; LENGTH (WATER LINE), 575 FEET; BEAM, 84-1/4 FEET; MEAN DRAUGHT, 28-1/4 FEET; SPEED, 20 KNOTS  
ARMAMENT: TEN 14-INCH, TWENTY-ONE 6-INCH, FOUR 1-PDRS., FOUR 3-PDRS. (SALUTING), FOUR 21-INCH TORPEDO TUBES. SUBMERGED. COMPLEMENT, 800.  
(69)



Photograph by Stephen Cribb, Southampton.

BRITISH DESTROYER LAUREL (L CLASS)

DISPLACEMENT, 887 TONS; ENGINEER, 24,000 H.P.; DESIGNED SPEED, 36 KNOTS; THREE 4-INCH GUNS; TORPEDO TUBES, FOUR 21-INCH  
(70)



Photograph by Boston Photo News Co.

BRITISH SUBMARINE TYPE "D"  
DISPLACEMENT: SURFACE, 565 TONS; SUBMERGED, 600. SPEED: 16 KNOTS. 9 TORPEDO TUBES, 3. CAN REMAIN BELOW 48 HOURS; CARRIES FUEL (HEAVY OIL) FOR A RADIUS OF 4000 MILES.  
IN THE ILLUSTRATION A RAPID-FIRE GUN, WHICH DISAPPEARS THROUGH A HATCH WHEN THE BOAT IS SUBMERGED, IS SHOWN  
(71)

In some cases it is difficult to distinguish the battle-cruiser from the dreadnought battleship. Battle-cruisers are designed primarily for advance skirmishing, but they are capable of taking their place in the line of battle. The characteristic features are great size, great speed, heavy armor, heavy guns, massive appearance (although the lines are somewhat finer than those of a battleship), low freeboard, broad beam, and large turrets.

Of the *battleship* the characteristic features appear from what has been said above of the dreadnought.

The *armored cruiser* has the essential characteristics of the battleship, but its armor is lighter and extends over a comparatively smaller area, and its guns are fewer in number; its speed, however, exceeds by several knots that of the battleship of the same period. In other words, armor and armament have, to a certain extent, been sacrificed for speed. Its characteristic features are medium size, moderate speed, medium armor, medium guns, fine lines, high freeboard, medium beam, medium turrets.

*Monitors* are heavily armored and carry a limited number of guns of large caliber. They carry one or two turrets with guns of large caliber, have an extremely low freeboard, and have heavily armored sides. The maindeck is also armored. Speed and offensive power have been sacrificed for protection. The type has never been adopted except in the United States, and in this country it has fallen into disuse. It would be of value only in coast defense or harbor work. Its characteristic features are low speed, heavy armor, medium guns, very low freeboard, medium size, medium beam, medium turrets.

*Protected cruisers* differ essentially from armored cruisers in having no side armor, the protection consisting exclusively of a protective deck. Their purpose is to patrol the ocean, convoy merchantmen, prey on the enemy's commerce, and, in peace time, to show the flag and to serve as international police. Their characteristic features are small size, moderate speed, small guns, fine lines, high freeboard, narrow beam, large coal capacity, and guns mounted behind shields.

*Scout cruisers* have higher speed than any ships except torpedo craft (and some late battle-cruisers) and are intended to cruise in company with the fleet or precede the fleet for scouting. They are of light construction, and are armed with guns of power adequate only to repel small craft. Their characteristic features are great speed, small guns, fine lines,

high freeboard, narrow beam, no armor (generally), and guns behind shields.

*Gunboats* may be classed as small cruisers. They serve in peace time for patrol and police duty, and, in war time, for picket duty, etc. There are special types, called river gunboats, which are built with light draft for service up rivers and in shallow harbors. All have small size, low speed, no armor, high freeboard, and a few small guns.

*Destroyers* were originally built to operate against torpedo-boats, but soon appropriated to themselves the functions of the latter and are now, together with submarines, the chief medium of torpedo attack on large vessels. They are of extremely light construction and are built largely with a view to obtaining high speed. They have no armor, great speed, small guns (few in number and mounted behind shields), high bow, and torpedo tubes, and to reduce weight to a minimum they carry only necessities.

*Torpedoboats* were designed for torpedo attack on large vessels, are smaller than destroyers, and appeared first. They are no longer built and are used only in coast defense and harbor operations. Their characteristic features are great speed, small size, no armor, torpedo tubes, and few guns (small and behind shields).

*Submarines* are designed to operate beneath the water in torpedo attack, and have moderate speed, no armor, torpedo tubes, and no guns (although the latest types carry two rapid fire guns).

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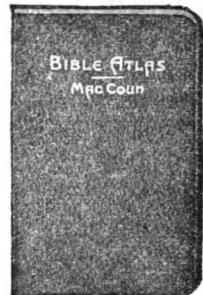
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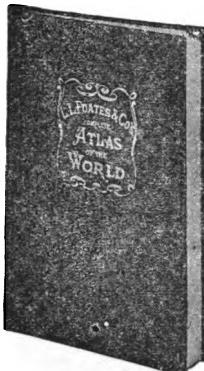


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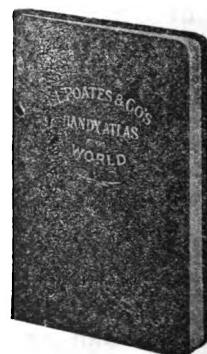
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## **APPENDIX "A"**

### **EXAMINATION FOR GUNNERS AND FOR SPECIAL RATINGS**

#### **EXAMINATION FOR GUNNERS**

(Numbers refer to paragraphs in the 1914 Drill Regulations.)

806. Boards of examination will be convened annually in each coast defense command by the coast defense commander, to meet, if practicable, just prior to, or just after the close of the indoor instruction period. Separate boards may be convened for the examination of candidates for first and for second class gunners, and separate boards may be convened for the different forts in a coast defense command. Each board will consist of three coast artillery officers. When a member of the board is a company commander he will be relieved by another officer during the examination of candidates from his company.

807. For purposes of instruction and examination, enlisted men of the Coast Artillery Corps not belonging to companies or batteries, upon application, will be attached to convenient organizations, and upon qualification will be classified as gunners.

Enlisted men of the Coast Artillery Corps on duty outside of a coast defense command may be examined by one or more coast artillery officers with whom they are serving or by coast artillery officers designated by the department commander, and, if found qualified, will be announced as gunners by the department commander.

When a mine planter or cable ship is assigned to a coast defense command, the coast artillery enlisted men assigned to the vessel may be examined by the officers on duty with the vessel, and, if found qualified, will be announced as gunners by the coast defense commander.

808. A candidate to be eligible for qualification as first-class gunner must have qualified previously as second-class gunner, though both qualifications may be made at the same examination.

809. The examination of gunner candidates will be held, as far as practicable, at such places as the material pertaining to the subject in hand is located, and will be made as practical as possible. In determining the qualifications of candidates, credit will be given for practical knowledge of subjects, rather than for text-book answers to questions.

810. The qualifying mark for classification as first or second class gunner will be in each case not less than an average of 75 per cent. Whenever, during the progress of the examination of a candidate for either grade, the sum of the marks received on subjects for which he has already been examined, increased by the maximum allowed for the remaining subjects, is less than 75, he will be disqualified and his examination will be discontinued. Whenever, during the progress of the examination of a candidate for either grade, the sum of the marks received on the subjects in which he has already been examined is 75 or more, he will be qualified without any further examination.

811. The board will keep a record of its marks during the examination,  
(i)

but these marks will not be published in orders. The report of the board on each company will be sent as soon as practicable after the completion of the examination to the coast defense commander, who will publish an order announcing the names of those who have qualified as first and second class gunners, and the date of qualification (the date of the completion of the company examination being taken as the date of qualification).

812. The scope of the examination for the first and second class gunners and the relative weights to be given the subjects will be as follows:

For candidates in companies assigned to coast defense:

For second-class gunners:

(a) Service of the piece (practical). This will include an actual drill at the battery in which the candidate will in turn perform the duties of various numbered cannoneers, the range setter, the chief of breech, the elevation setter (mortars only), and the azimuth setter (mortars only), or as many of those duties as the board may direct	40
(b) Nomenclature of the various parts of the gun and carriage	5
(c) Action, adjustment, and care of the various parts of guns and carriages	20
(d) Powders, projectiles, primers, and fuses	10
(e) Cordage, gins, shears, and jacks	10
(f) United States magazine rifle	15
	100

For first-class gunners:

(a) The azimuth instrument (theoretical, 5; practical, 10)	15
(b) Duties in the plotting room (theoretical, 20; practical, 30). The candidate will act in turn as Nos. 1, 2, 3, 4, and 5 while tracking a moving target (if practicable), or in as many of those positions as the board may direct	50
(c) Aiming and laying guns or mortars, practical	15
(d) Time-range board (guns) and time-azimuth board (mortars), practical	10
(e) Definitions, C.A.D.R.	5
(f) Warships, characteristic features	5
	100

The examination of candidates for first-class gunners of organizations assigned exclusively to rapid-fire guns not provided with separate position finding system will include the following head in lieu of those given under (b) and (d).

(b) (d) Subcaliber firing

The examination in subjects (a), (b), (c), and (d) for both second-class and first-class gunners will be confined to the materiel of that part of the defense to which the company is assigned. If no azimuth instrument is included in the battery equipment, the instrument used in the instruction will be used in the examination.

#### EXAMINATION FOR SPECIAL RATINGS

813. In each company of coast artillery, examinations will be held by the company commander under the direction of the fire or mine commander,

at such times as the later may prescribe, for the purpose of determining enlisted men who are qualified for appointment to rated positions.

814. Records will be kept in each company in the form of eligible lists for each rated position to which enlisted men of the company may be appointed.

815. Examination for rated positions will be confined to first-class gunners or enlisted men who have once been classified as first-class gunners. Candidates who pass with an average of 75 per cent of any of the examinations prescribed for rated enlisted men will be carried on the qualified list for appointment to the corresponding rated position for a period of one year from the date of examination.

816. Enlisted men on the qualified list for a rated position will be classified as first-class gunners from the date of qualification and so announced in coast defense orders, and such classification will be continued for the time they are entitled to remain on such qualified list. When a man's term of qualification for any rated position expires, he may be continued in such rated position or on the corresponding qualified list by passing a new examination for such rated position, and his classification as first-class gunner will be continued without further examination.

817. The same enlisted man may be carried on several qualified lists provided he passes satisfactorily the prescribed examinations for such rated positions.

818. Prior to the examination for the rated positions of observers, first or second class, or gun pointer, the candidates will be examined by the post surgeon for defective vision, and no candidate will be rated for these positions who has any defect in vision which would impair his efficiency.

819. An enlisted man holding a rated position need not be required to take the examination for that position until the termination of the one-year period from the date of his last classification as a first-class gunner, unless his qualifications for the position he holds have not been established to the satisfaction of the fire or mine commander concerned or the coast defense commander, in which case he will be required to take the examination for that position at such time as may be prescribed by the fire or mine commander concerned. In the event of his failure to pass satisfactorily the prescribed examination, he will be disgrated immediately by the coast defense commander.

820. The scope of the examination for each of the rated positions will be as follows:

**GUN COMMANDER AND GUN POINTER**

**I. Definitions C.A.D.R.**

**II. Gun and carriage.**

(a) Nomenclature, purpose, and action of several parts.

(b) Packing stuffing boxes and cleaning recoil cylinders.

(c) Adjustment of—

Quadrant elevation device, sight standard, throttling valve, gas-check pad, elevating gear, grease cups, and firing mechanism.

(d) Care and preservation, including care of hand counter-weights, oiling, and painting.

**III. Powders, projectiles, fuses, and primers.**

(a) Blending powder and preparation of powder charges.

- (b) Filling and fusing projectiles.
- (c) Painting projectiles.
- IV. Preparations for service or subcaliber practice.
- V. Service of the piece.
  - (a) Duties of each member of the gun section under all conditions.
- VI. Precautions for safety at the battery.
- VII. Pointing.
  - (a) Methods of pointing and pointing tests.
  - (b) The telescopic sight (the quadrant for mortars).
  - (c) Emergency system and salvo points.
  - (d) Bore sighting and orientation.
- VIII. Regulations governing service and subcaliber practice so far as they affect the service at the emplacements.
- IX. Mounting and dismounting guns and carriages.
- X. Characteristic features of the several classes of war ships, general knowledge of local shipping, of channels leading to the harbor, and of ranges to prominent fixed objects in the field of fire of the battery.

**PLOTTER**

- I. Definitions C.A.D.R.
- II. Position finding system.
  - (a) Detailed knowledge of system employed at the battery.
  - (b) Indication and identification of targets.
  - (c) Duties of each member of the range section under all conditions.
  - (d) Emergency system and salvo points.
- III. Position finding apparatus.
  - (a) A detailed knowledge of adjustments and use of all position finding apparatus used in the plotting room.
- IV. Elementary gunnery.
  - (a) Explanation of the several corrections to be applied to the observed range to obtain the corrected range.
  - (b) Effect on the flight of the projectile of variations in the density of the air; the direction and velocity of the wind.
  - (c) Use of trial shots and application of data obtained from them (problem).
- V. Preparation of target-practice records.

**OBSERVER (FIRST OR SECOND CLASS)**

- I. Definitions C. A. D. R.
- II. Position finding system.
  - (a) Detailed description of that in use at the battery.
  - (b) Indication and identification of targets.
  - (c) Emergency system and salvo points.
- III. Position finding apparatus.
  - (a) A detailed knowledge of adjustment and use of all observing instruments and range finders in use at the battery.
  - (b) Use of the telephone.
- IV. Characteristic features of the several classes of war ships, general knowledge of local shipping, of channels leading to the harbor, and of ranges to prominent fixed objects in the field of fire of the battery.

## APPENDIX "B"

### EXTRACTS FROM DRILL REGULATIONS, COAST ARTILLERY, 1914

#### I. DEFINITIONS

(Numbers refer to paragraphs in the Drill Regulations.)

577. *Aiming.*—[Pointing the gun by means of a sight.] See "Pointing."

578. *Ammunition.*—A general term applied to projectiles, explosives used for propelling projectiles, explosives used for filling projectiles, primers used for discharging guns and mortars, and fuses used for exploding projectiles. When the projectile, propelling charge, and primer are held permanently together by a metallic case inclosing the powder and primer, or otherwise, in condition to be handled as a unit in loading, the ammunition is called "fixed ammunition." When the projectile, propelling charge, and primer are not so held together, but are handled separately in loading, the ammunition is called "separate-loading ammunition."

581. *Angle of departure.*—The angular elevation of the line of departure above the line of sight. Quadrant angle of departure is the angular elevation of the line of departure above the horizontal plane through the muzzle of the gun in the firing position. (See Fig.\*)

582. *Angle of depression.*—The angular depression of the line of sight below the horizontal plane (See Fig.\*)

583. *Angle of fall.*—The angle between the line of fall and the horizontal plane through the muzzle of the gun in the firing position. It is often represented by its slope; for example, 1 on 10. (See Fig. \*)

584. *Angle of impact.*—The angle between the line of impact and the tangent to the surface at the point of impact. It is the complement of the angle of incidence. (See Fig.\*)

585. *Angle of incidence.*—The angle between the line of impact and the normal to the surface at the point of impact. (See Fig. \*)

586. *Angle of jump.*—The angular elevation of the line of departure above the position of the axis of the bore at the time the piece was pointed. In determining the sight or quadrant elevation to be used, this angle must be subtracted algebraically from the angle of departure given in the range table; the angle of jump differs for different guns, carriages, and ranges, and is determined by experiment.

588. *Apron.*—That portion of the superior slope of a parapet or the interior slope of a pit designed to protect the slopes against blast.

589. *Axis of cannon or axis of bore.*—The central line of the bore.

590. *Axis of trunnions.*—The central line of the trunnions.

591. *Azimuth (of a point).*—In coast artillery usage, the horizontal angle measured in a clockwise direction from the south line through the observer's position to the line from the observer to the point. For example, the azimuth of a point B from A is the angle (measured clockwise from the south) between

\* See diagram in "First Class (e)."

the north and south line through A and the line from A to B. The north point has an azimuth of 180°.

592. *Azimuth difference*.—The difference between two azimuths of a point as read from two other points, as, for example, the difference in azimuths of a target as read from the primary station and from the directing point of the battery.

594. *Base line*.—A horizontal line, the length and direction of which have been determined. This line is used in position finding, especially for long ranges; the stations at its ends are called "observing stations." It is called "right-handed" or "left-handed," depending on whether the secondary station is to the right or left of the primary from the point of view of a person facing the field of fire. The base end observing stations are called primary, secondary, or supplementary.

600. *Blending*.—The process of mixing powders of the same or different lots so as to obtain charges of uniform characteristics.

601. *Bore*.—The interior of a cannon forward of the front face of the breechblock. It is composed of the gas check seat, the powder chamber, the centering slope, the forcing slope, and the rifled portion called the "main bore." The *length of bore* is the distance from the front face of the breech-block proper (not the mushroom head), when in position, to the face of the muzzle, measured along the axis of the bore.

602. *Breech*.—The mass of metal behind the plane of the rear section of the bore of a cannon, the section being taken at right angles to the axis of the bore.

603. *Breechblock*.—The metal plug which closes the breech of a cannon.

604. *Breech bushing*.—That part of the breech on the interior surface of which the treaded and slotted sectors of the breech recess are formed.

605. *Breech, face of*.—The rear plane of a cannon perpendicular to the axis of the bore.

606. *Breech mechanism*.—The breechblock, obturating device, firing mechanism, and all parts used in operating the breechblock of a cannon.

607. *Breech recess*.—The opening in a cannon which receives the breech-block.

608. *Breech reinforce*.—The part of a cannon in front of the breech and in rear of the trunnion band.

609. *Caliber*.—The diameter of the bore in inches, measured between diametrically opposite lands. It is the minimum diameter of the rifled portion of the cannon.

610. *Cannon*.—Artillery weapons from which projectiles are thrown by the force of expanding powder gases. (See "Gun or piece.")

Cannon are of three classes: Guns, mortars, and howitzers.

Guns are long (generally 30-50 calibers), have flat trajectories, and are used for direct fire (not exceeding 20°), with high velocities.

Mortars are short (about 10 calibers), and are used for high-angle fire (above 45°), with low velocities.

Howitzers are short guns and are used for curved fire (not exceeding 45°) with low velocities.

Cannon of the United States land service are classified according to their use into coast, siege, field, and mountain.

Built-up cannon are made by shrinking forgings (jacket and hoops) over an inner tube. Wire-wound cannon are made by winding wire under tension

around a tube; a jacket and hoops may be shrunk over the wire-wound tube.

613. *Cap-square*.—That part of a gun or mortar carriage which fits over the trunnion and holds the trunnion in the trunnion-bed.

614. *Carriage or mount*.—The means provided for supporting a cannon. It includes the parts for giving elevation and direction, for taking up the recoil on discharge, and for returning the piece to the firing position.

617. *Carriages, seacoast*.—Those used for coast artillery cannon. They may be divided into four classes, depending upon the nature of cover afforded by the emplacements.

(a) *Barbette*: Where the gun remains above the parapet for loading and firing. Barbette carriages are used for guns of 3-inch or greater caliber. The pedestal mount is a type of barbette carriage used for guns up to six inches in caliber.

(b) *Disappearing*: Where the gun is raised above the parapet for firing, and recoils under cover for loading. This mount is used for guns of 6-inch or greater caliber.

(c) *Masking parapet mount*: Where the gun remains above the parapet for loading and firing but can be lowered below the level of the crest for concealment. This mount is also called the balanced pillar mount and is used for guns up to five inches in caliber.

(d) *Casemate*: Where the gun fires through a port.

626. *Charge*.—The explosive placed in a gun or mortar behind the projectiles as a propellant (propelling charge). Also the explosive placed in the cavity of a projectile (bursting charge).

627. *Charge (or powder) section*.—One of the component parts of a charge when the charge is made up of two or more separate parts.

628. *Chase*.—That part of a cannon in front of the trunnion band.

630. *Chord of the trajectory*.—The straight line joining the extremities of the trajectory, i.e., the straight line from the muzzle of the gun (in the firing position) to the point of splash. (See Fig.\*)

638. *Counterweight*.—The weight used in bringing a gun on a disappearing carriage to the firing position. The pit in the gun platform for the reception of the counterweight is called the counterweight well.

641. *Danger space*.—The horizontal distance within which a target of a given height would be hit by a projectile. The danger space varies with the range, the flatness of the trajectory, the height of the target, and the height of the gun above the target.

The maximum range which is all danger space is called the "danger range."

644. *Deflection*.—The angle between the plane of sight and plane of departure; it is usually expressed as a reference number, and is set off on the sight deflection scale.

645. *Delivery table*.—The hoist table from which the projectiles are delivered to the trucks.

647. *Deviation*.—As used in coast artillery practice, deviations are either the horizontal distances of the points of splash from the center of the target, or the rectilinear co-ordinates of those distances. Deviations are measured in a plane passing through the water line of the target and parallel to the horizontal plane through the muzzle of the piece in the firing position.

(a) *Absolute deviation*.—The shortest distance between the center of the target and the point of splash.

See diagram in "First Class (e)"

- (b) *Lateral deviation.*—The distance between the plane of direction and the plane of splash measured (right or left) from the center of the target and perpendicular to the plane of direction.
- (c) *Longitudinal deviation.*—The perpendicular distance (over or short) of the point of splash from the vertical plane passing through the center of the target and perpendicular to the plane of direction.
- (d) *Mean lateral deviation.*—The algebraic mean of the lateral deviations of a series of shots.
- (e) *Mean longitudinal deviation.*—The algebraic mean of the longitudinal deviations of a series of shots.
- (f) *Mean absolute deviation.*—The algebraic mean of the absolute deviations of a series of shots.
- (g) *Range deviation.*—The difference between the range to the target (at the instant the projectile strikes) and the range to the point of splash. The range deviation is equal to the longitudinal deviation when the lateral deviation is zero.

650. *Directing point.*—A point at or near the battery for which relocation is made at the plotting room. It is the point for which the gun center of the plotting board is adjusted. When the pintle center of a gun is taken as the directing point, such gun is called the "directing gun."

651. *Drift.*—The divergence of the projectile from the plane of departure due to the rotation of the projectile and the resistance of the air. It is affected by the ballistic character of the projectile. It is in the direction of rotation and for the United States service rifled guns it is to the right. It may be expressed either in yards or degrees.

654. *Elevation.*—The inclination in a vertical plane given to the axis of the bore in pointing a gun; the angular elevation of the axis of the bore above the line of sight is the sight elevation; the angular elevation of the axis of the bore above the horizontal is the quadrant elevation.

656. *Emplacement.*—That part of the battery pertaining to the position, protection, and service of one gun, mortar, or group of mortars.

661. *Equalizing pipe.*—A pipe connecting the front ends of two recoil cylinders for the purpose of equalizing the pressure therein.

667. *Exterior slope.*—The outer slope of the battery.

668. *Field of fire.*—The area covered by the armament of a battery, or with reference to a single gun, it is the area covered by that gun.

678. *Forcing slope.*—The part of the bore immediately in front of the centering slope. The rifling begins at the junction of the centering slope and the forcing slope. The tops of the lands at this point are cut down so that less power is required at first to force them through the copper rotating band. The lands attain their full height at the front end of the forcing slope.

680. *From battery.*—The position of a gun when withdrawn from its firing position.

681. *Fuse.*—A device attached to a projectile for the purpose of causing the explosion of the bursting charge either by impact or at the expiration of a certain time of flight. Fuses are classified according to construction, as ring resistance, combination time and percussion, centrifugal, and detonating; they are classified according to location in the projectile as point and base.

682. *Gallery.*—Any passageway covered overhead and at the sides.

684. *Gun or piece.*—A general term applied to any firearm from which a missile is propelled by the force of expanding gas. In a restricted sense,

the term "gun" is applied as defined under "Cannon."

687. *Gun platform.*—That part of the battery upon which the gun carriage rests.

690. *Hoist room.*—The room in a battery containing the receiving table of the ammunition hoist.

691. *Hoop.*—A forging superposed upon the jacket, tube, or other hoops of a cannon.

692. *In battery.*—The position of a gun when ready for firing.

694. *Interior crest.*—The line of intersection of the interior slope with the superior slope. If there be no interior slope, it is the line of intersection of the interior wall and superior slope.

695. *Interior slope.*—The inner slope of a parapet connecting the interior wall and superior slope.

697. *Jacket.*—The principal forging shrunk on the breech end of a tube of a cannon.

700. *Line of departure.*—The direction of the axis of the bore when the projectile leaves the muzzle of the gun. (See Fig.\*)

701. *Line of direction.*—The straight line from the muzzle of the gun (in the firing position) to the center of the target at the instant the shot strikes. (See Fig.\*)

702. *Line of fall.*—The tangent to the trajectory at the point of fall. (See Fig.\*)

704. *Line of sight.*—The axis of collimation of the telescope or the straight line passing through the sights of the piece; at the instant of firing this line passes through the center of the target.

705. *Load.*—A single charge of powder and a single projectile as combined for firing in a gun or mortar.

706. *Loading platform.*—That surface upon which the gunners stand while loading the piece.

707. *Loading tray.*—A device used to protect the breech recess while loading the projectile.

710. *Magazine.*—A room for storage of powder, primers, or fuses, etc.

715. *Muzzle.*—The front end of a cannon. The face of the muzzle is the front plane of the gun perpendicular to the axis of the bore.

717. *Obturator.*—A device for preventing the escape of gas. Obturation is the process of preventing the escape of gas.

720. *Parapet.*—That part of a battery which gives protection to the armament and personnel from front fire.

725. *Pit.*—That part of a mortar emplacement designated for mounting one or more mortars, usually two or four.

726. *Plane of departure (also called plane of fire).*—The vertical plane containing the line of departure.

727. *Plane of direction.*—The vertical plane containing the line of direction.

728. *Plane of sight.*—The vertical plane containing the line of sight.

729. *Plane of splash.*—The vertical plane containing the chord of the trajectory.

731. *Point of impact.*—The point at which the projectile first strikes. When the projectile strikes the water before striking any object, the point of impact and the point of splash are the same. (See Fig.\*)

733. *Pointing.*—The operation of giving the direction and elevation

\* See diagram in "First Class (e)."

necessary to hit the target. When the sight is used it is called "aiming"; when the sight is not used, it is called "laying."

There are three cases of pointing:

Case I. When direction and elevation are both given by the sight.

Case II. When direction is given by the sight, and elevation by the range scale on the carriage or by quadrant.

Case III. When direction is given by the azimuth scale, and elevation by quadrant or by the range scale on the carriage.

734. *Position finder*.—An instrument for locating a target.

736. *Powder chamber*.—The portion of the bore for the reception of the powder charge. It is between the breech recess and the centering slope.

737. *Predicted point*.—The point at which it is estimated a target will arrive at the end of an assumed interval of time reckoned from the time of the last observation on which the estimate is based. This interval of time is called the "predicting interval."

738. *Predictor*.—An accessory of the plotting board used to locate the position of the predicted and the set-forward points on the plotting board.

740. *Primer*.—The device used for igniting the propelling charge. Primers may be friction, percussion, electric, or combination (electric and friction).

741. *Priming charge or igniter*.—Small charges of black powder in the ends of powder sections necessary for the ignition of smokeless powder.

742. *Projectile*.—The term applied to a missile thrown from a fire arm by an explosive. The principal parts of an armor-piercing projectile are the ballistic cap, the armor-piercing cap, the nose or point, the ogive, the bourrelet, the body, the rotating band, the cavity, the base, the base plug, and the fuse plug, as shown in the diagram [in "Second Class (d)"].

The ballistic cap is for the purpose of reducing the effect of, or the retardation due to, the resistance of the air. It consists of a hollow metal cap placed over the armor-piercing cap.

The armor piercing cap is a piece of soft steel placed over the point to prevent the point from bending or breaking on impact against hard-faced armor, and to thereby increase penetration.

The lower part of the ogive is turned off to make a cylindrical bearing surface for the front part of the projectile. This surface, called the bourrelet, has a diameter slightly less than the caliber of the gun, but greater than that of the cylindrical portion of the projectile.

The rotating band is forced through the rifling of the bore and gives rotation to the projectile. The rotating band also seals the grooves and prevents the escape of gas. When the rifling is worn, due to erosion, broader bands are necessary. Rotation is given to the projectile in order to prevent the projectile from tumbling end over end in the air. The rotation in our service is clockwise, as viewed from the base of the projectile. The base and fuse plugs are arranged to screw to the left so that the rotation of the projectile to the right may have no tendency to unscrew them.

Coast artillery projectiles are cast-iron or steel. The service projectiles are the armor-piercing shot, the armor-piercing shell, and the shrapnel. The shot has a thicker wall and contains a smaller bursting charge than the shell. \* \* \* The shrapnel is a projectile which carries a number of bullets to a distance from the gun, and there discharges them over an extended area.

745. *Range*.—In a limited sense, the horizontal distance from the gun to the target. In a general sense, it is applied to horizontal distances between position finder and target, position finder and splash, gun and splash, etc. The range of a shot is the horizontal distance from the muzzle of the gun in the firing position to the point of splash. (Practically, the range is reckoned from the axis of the gun trunnions in the firing position, instead of from the muzzle, but the difference in range is negligible.) \* \* \*

746. *Range-azimuth table*.—A table of ranges and the corresponding azimuths from a gun to points in the center of the main ship channel or channels. It is kept at the gun and used for firing without the use of range-finding apparatus.

752. *Receiving table*.—The hoist table on which projectiles are placed preparatory to raising.

753. *Recoil*.—The backward movement of the gun on firing. Counter recoil is the return of the gun in battery.

754. *Recoil cylinders*.—Hydraulic cylinders for controlling the recoil.

758. *Rifling*.—Helical grooves cut in the surface of the bore for the purpose of giving a rotary motion to the projectile. The rib of metal between two adjacent grooves is called a "land." (See "Twist of rifling.")

759. *Rimbases*.—The masses of metal uniting the trunnions of a cannon with the trunnion band.

760. *Round*.—The firing of a single load from each gun of a battery not simultaneously.

761. *Salvo*.—The simultaneous firing of a single load from each gun or mortar of a battery, or from each mortar of a pit. The former is called a "battery salvo" and the latter a "pit salvo."

762. *Salvo point*.—A selected point on which a salvo from one or more batteries may be centered, the range and azimuth having been carefully determined.

763. *Salvo table*.—A table giving ranges and azimuths of salvo points.

765. *Set-forward point*.—A point on the course of a target in advance of the plotted point at which it is estimated that a target will arrive, at the end of the predicting interval plus the time of flight for the range. It is located (on the plotting board) by laying off from the last plotted position of the target, along the estimated course of the target, a distance equal to the travel of the target during the predicting interval plus the time of flight.

766. *Shell*.—A projectile with a large cavity for explosive.

768. *Shell room or shot room*.—A room for the storage of projectiles.

769. *Shell tracer*.—A device attached to the base of a projectile which enables its flight to be followed. In the day time a smoke (which is visible) is emitted and at night a bright flame.

770. *Shot*.—A projectile with a small cavity for explosive; also the firing of a single load from a single gun or mortar.

771. *Shot gallery*.—A gallery for the storage of projectiles.

772. *Shot hoist*.—A device for raising projectiles from the hoist room to the loading or truck platform. Sometimes called ammunition hoist.

773. *Shot hoist well*.—The shaft through which the projectile hoist operates.

775. *Sight*.—A device by which the gun pointer gives the gun the proper direction for firing. Sights are of two classes, open and telescopic.

779. *Striking velocity*.—The velocity of the projectile at the point of impact.

782. *Superior slope*.—The top slope of a parapet or traverse.
783. *Swell of the muzzle*.—The enlargement of the exterior of a cannon at the muzzle.
784. *Targ*.—The piece of metal (or other material) used to indicate the intersection of the arms on the plotting board.
785. *Throttling bar*.—A bar in the recoil cylinder to regulate the size of the orifice through which the oil escapes from one side of the piston head to the other.
786. *Throttling pipe*.—A pipe connecting the rear ends of two recoil cylinders. The throttling and the equalizing pipes are joined by a connecting pipe through which oil flows from one end of the cylinders to the other without passing through the piston heads. The amount of oil which passes through the connecting pipe is controlled by the throttling valve. The recoil of the gun can be controlled to a certain extent by varying the setting of the throttling valve.
787. *Time interval bell or T. I. bell*.—A bell to indicate the observing interval. Bells ring simultaneously at the emplacements and the observing stations. They are operated by a clock or a motor.  
[*Time of flight*.—The time required for the projectile to travel from the gun to the target.]
790. *Trajectory*.—The curve described by the center of gravity of the projectile in passing from the muzzle of the gun to the point of impact.
- \* \* \* \* \*
791. *Travel of projectile*.—The distance from the base of the projectile in its seat to the face of the muzzle of the cannon.
792. *Traverse*.—The structure protecting the armament and personnel from flank fire.
797. *Truck platform*.—If the ammunition trucks run on a different surface from that of the loading platform, this surface is called the "truck platform."
798. *Trunnions*.—The cylinders which rest in bearing surfaces of the carriage called "trunnion beds." Their axis is perpendicular to the axis of the bore and ordinarily in the same plane; they connect the cannon with the carriage and transmit the force of recoil from one to the other. The faces of the trunnions are the end planes perpendicular to their axis.
799. *Trunnion band*.—The hoop of which the trunnions of a cannon form a part.
800. *Tube*.—The inner cylinder of a cannon.
801. *Twist of rifling*.—The inclination of the grooves to the axis of the gun at any point. When this inclination is constant the twist is uniform; when it increases from the breech to a point near the muzzle it is increasing. Twist is generally expressed in turns per caliber, e.g., one turn in 50 calibers, meaning that the projectile makes one complete rotation in passing over a distance equal to 50 calibers, provided the twist were uniform. In most of the major caliber guns in our service, the twist increases from one turn in 50 calibers to one turn in 25 calibers at a short distance from the muzzle, and beyond that point it is uniform.
803. *Vent*.—A small channel leading from the exterior of the cannon to the powder chamber for the ignition of the powder charge. It is an "axial vent" when it is in line with the axis of the bore. It is a "radial vent" when it is at right angles to the axis of the bore.

804. *Zone*.—In mortar firing, the area in which projectiles fall for a given charge of powder, when the elevation is varied between the minimum and maximum.

It is also used with reference to other divisions of the defensive area, as "outer defense zone," "inner defense zone," etc. \* \* \*

## II. ORGANIZATION

22. A gun company will be divided into sections as follows: one range section, and for each emplacement, one gun section. The sections will be subdivided into detachments and details for manning the matériel to which assigned.

23. A mortar company will be divided into sections as follows: One range section, and for each pit, one pit section. The sections will be subdivided into detachments and details for manning the matériel to which assigned.

25. The senior noncommissioned officer of each section, detachment, or detail is its chief. Each chief will command his subdivision and will be responsible for its drill, its efficiency, and the condition of the matériel to which it is assigned.

### MARCHING MANEUVERS

The company is formed and marched off according to drill regulations. (Paragraphs 37 to 39).

#### To Post the Sections

40. The company commander marches his company to its battery or station, and as he approaches the battery or station commands *SECTIONS POSTS*. At the second command, each chief of section falls out of ranks, marches his section to a point near its emplacement or station, and commands *DETAILS POSTS*. At the second command all details fall out, procure equipments and implements, and take their posts.

Each chief of section determines whether all apparatus and material to be served by his section is in order, and reports to the officer directly over him, "Sir——in order" or reports defects he is unable to remedy without delay. As soon as the chiefs of section have reported, the officers report to the battery commander, who then reports to the fire commander "——in order" (inserting name of battery), or reports defects he is unable to remedy without delay. (The reports from mine companies are made to the mine commander.)

If he so desires, a company commander may post the sections separately, at any point of the march, by commanding:—*SECTION, POST*. The section designated is posted as described above.

When a range section leaves the column, the range officer falls out and proceeds direct to his station.

Details for remote stations may be marched to their stations from the company parade by their respective chiefs.

#### To Dismiss the Sections

41. Battery commanders command *DISMISSED*. Range officers command *CLOSE STATION* (or *CLOSE STATIONS*). Emplacement officers command *REPLACE EQUIPMENTS*. Chiefs of sections command *FORM SECTION*. The company is formed on the battery parade and is marched by the battery commander to the company parade and dismissed.

Subdivisions from remote stations are marched to the company parade and dismissed by their chiefs.

### III. GENERAL DUTIES

#### OBSERVERS

61. Observers will be selected on account of their special aptitude. They will understand thoroughly the use of their instruments and will have a knowledge of the general characteristic features of warships. Each observer is responsible for the care and adjustment of his instrument and for the police of his station at all times, and will report to the range officer deficiencies, defects, or accidental damages as soon as they are known.

62. Ranges to moving targets as determined by depression position finders and coincidence range finders will be compared frequently (if practicable) with ranges as determined by a long horizontal base.

63. Observers will be tested frequently as to their proficiency in the practical use of the instruments to which assigned. The test will be conducted so as to determine the relative ability of various observers to read quickly and accurately ranges to fixed and moving objects.

#### THE GUN AND PIT COMMANDERS

69. Each emplacement of a gun battery is commanded by a gun commander and each pit of a mortar battery by a pit commander, who is responsible to the emplacement officer for the condition of the matériel and the efficiency of the personnel of his section. The gun (or pit) commander will supervise the gun cleaning and will require the mechanic to keep pieces and carriages in excellent condition. He will supervise the service of the piece.

70. The gun (or pit) commander will have charge of the entire emplacement under the emplacement officer, and during the absence of the emplacement officer, he will perform the duties prescribed for the emplacement officer. After the details have been posted as prescribed in Paragraph 40, he will command *EXAMINE GUN*. He will make a general inspection of the gun and carriage, paying especial attention to the recoil cylinders, the firing device, and the oiling of the various bearings. He will report to the emplacement officer, "Sir, No.—(or pit)— in order," or will report defects he is unable to remedy without delay.

71. At the conclusion of the exercises for the day, he will command *FORM SECTION* after the emplacement officer has commanded *REPLACE EQUIPMENTS* (Par. 41). He will supervise the replacing of equipments and implements, will see that the piece is secured, and will then form his section on the battery parade.

#### THE GUN POINTER

72. A gun pointer is assigned to each gun in commission and is responsible for the condition and adjustment of the sight and sight standard. He will have a general knowledge of the characteristic features of warships. He will be tested frequently as prescribed in Par. 224.

#### THE MECHANIC

73. One mechanic, or acting mechanic, is assigned, under the gun commander, to each 8-inch (or greater caliber) gun emplacement, to each mortar emplacement, and to each battery of the intermediate or minor armament in

service. He is in immediate charge of all small stores and supplies at the emplacement or battery to which assigned.

GENERAL INSTRUCTION

203. The service of the piece will proceed with alertness and precision, and with as few orders as possible; aside from the necessary orders and instructions, no talking of any kind will be permitted. All movements of the gunners connected with the service of the piece will be made at a run.

206. At the command *TAKE COVER*, given at any time, all gunners not designated to remain at their posts will move at a run to some designated place under cover. As a rule this command will be given in mortar batteries only.

207. A drill primer or a fired service primer will be used at drill.

208. The primer will be inserted after the breechblock is locked. The gunner who inserts the primer will be instructed to exercise the greatest care in lowering the leaf of the firing device. Under no circumstances will he insert or remove the primer by means of the button or wire.

209. Service friction primers are adjusted in manufacture to require a pull of about 25 pounds to start the wire to the rear, and about 40 to 45 pounds to pull the teeth through the compressed friction pellet and explode it.

210. The lanyard will be pulled from a position as near the rear of the gun as possible. A strong, quick pull (not a jerk) with as short a lanyard as practicable, will be used.

211. Obturating primers are constructed so that when a primer is pulled and fails to fire, the primer wire is free to move forward without causing the composition to ignite. Extra precaution will be taken to prevent any attempt to use a primer that has failed.

212. Constant inspection of the safety pin on the firing leaf of the breech mechanisms in which combination primers are used will be made, since if the safety pin should be broken by harsh treatment and the pull upon the lanyard be upward by about 10° the primer probably would be ejected at the instant of firing and might injure the man firing the piece.

213. *Signals*.—The commands or signals, *ELEVATE*, *DEPRESS*, *RIGHT*, or *LEFT*, given in pointing, always refer to the direction of motion of the muzzle.

*ELEVATE*.—Raise either hand to the height of the head, fingers pointing upward.

*DEPRESS*.—Raise either hand to the height of the head, fingers pointing downward.

*RIGHT* or *LEFT*.—Motion with either hand, fingers pointing in the desired direction.

*CLAMP*.—Raise either hand with fist closed opposite neck, back of hand up; elbow bent and at height of shoulder.

*HALT*.—Raise and fully extend either arm vertically, hand and fingers open in prolongation of arm.

*STAND FAST*.—Raise and fully extend either arm horizontally straight to the front, hand and fingers open in prolongation of arm, back of hand up.

*TAKE COVER*.—Raise and extend fully both arms horizontally in prolongation of line of shoulders, hands open, fingers extended and joined, backs of hands up.

*READY*.—Raise either hand horizontally in front of forehead, fingers extended and joined, back of hand against forehead.

*Care in Seating the Projectile at Gun Batteries of the Major Armament*

215. The shot truck carrying the projectile will be brought up to the face of the breech and the projectile pushed carefully of the truck until the base of the projectile is just inside the powder chamber. The truck will then be withdrawn and run off to one side. The entire ramming detail will then man the rammer as near its outer end as possible. At the command *HOME RAM* by the chief of breech, the ramming detail will rush the projectile forward hard into its seat, increasing the speed of the rush so that the projectile will have its fastest movement when it comes up hard in its seat.

216. *Powder serving tray*.—For guns of the major and the intermediate armament, there will be made wooden serving trays, each having sufficient dimensions to carry all the sections of one powder charge. The tray will be so shaped that the forward end will cover the screw threads in the breech, and it will be provided with cross handles to facilitate handling. Powder sections will be arranged in the same order they will have in the powder chamber.

217. As soon as the rammer has been withdrawn after seating the projectile, the nose of the powder serving tray will be inserted in the breech by the powder servers, and the rammer detail, in one motion, will push carefully the entire powder charge off the serving tray to such a distance that the breech block will give the powder charge a final push into the chamber in closing. The tray will then be removed and the breech closed. At least two trays will be provided for each gun.

**METHODS OF POINTING**

223. Case I.—This method of pointing is used only with rapid-fire guns where means for laying in elevation by quadrant have not been provided.

Direction and elevation are given by the sight.

The gun pointer adjusts the sight in its seat and sets the elevation and deflection scales for the indicated range and deflection, respectively.

Case II.—This is the normal method of pointing all guns. Direction is given by the sight, and elevation by an elevation or range scale attached to the carriage. For guns of the major armament the corrected range is taken from the time-range board. The gun pointer sets his sight to the deflection shown on the deflection recorder's board.

Case III.—This method of pointing is used exclusively for mortars. Its use for guns is auxiliary and is limited to batteries where the prevalence of fog or other local conditions render it necessary. Direction is given by the azimuth circle and elevation by the elevation scale or by quadrant.

In Case III, guns are fired on the bell. Corrected azimuths for the first or second bell after the data are received, are sent to the guns every thirty seconds. The gun pointer sets the azimuth for the bell on which it is desired to fire. The corrected range of the set-forward point for the same instant of firing is taken from the time-range board.

***Pointing Tests***

224. Pointing tests will be held frequently at gun batteries of the major armament in the following manner:

An assumed deflection for wind and drift is used during the test. This deflection is changed frequently during the drill so that gun pointers may not know the reading that should be obtained at the end of the time of flight. To accomplish this, the platen of the deflection board is set for the assumed

Deflection, and the setting is not changed as long as the same assumed deflection is used.

The gun pointer sets his sight at the deflection received from the plotting room, which is that obtained from the deflection board by combining the correction for angular travel during the time of flight with the assumed deflection for wind and drift. He gives the command *FIRE* as soon after the command *READY* as he is on the target; traversing is stopped and he then follows the target with the vertical wire. A noncommissioned officer equipped with a stop watch and a time of flight table starts the watch at the command *FIRE*; commands *HALT* and stops the watch at the expiration of the time of flight. The gun pointer stops following with the vertical wire at the command *HALT*, when the reading of the deflection scale should be the same as the assumed deflection for wind and drift. If not, the difference is the error in predicting and pointing.

*Example.*—Assumed deflection, 3.65; deflection sent to gun pointer, 3.20; reading of the deflection scale at end of time of flight, 3.60.  $3.65 - 3.60 = 0.05$ , the error.

For each trial, records will be kept of the range to the target and the deflection error; and the gun pointer will be informed concerning the amount of his error.

225. The excellence of a gun pointer's work is determined, first, by the accuracy of his pointing; second, by the promptness with which he is able to give the command *FIRE* after the piece is ready.

226. With disappearing guns it is important that the gun pointer be trained to get on the target in the time necessary to close the breech plus the tripping interval, so that in practice or action no time will be lost in pointing the gun after it is in battery.

#### *Prediction Tests for Mortar Batteries*

227. Prediction tests will be made frequently at mortar batteries in the following manner:

The battery commander is assisted by an officer, or noncommissioned officer, equipped with a stop watch and a time-of-flight table. The azimuth of a predicted point and the corresponding time of flight is sent to the battery commander, who sets his instrument to the azimuth of the predicted point, the vertical wire at normal. As the target passes the vertical wire of his instrument, he commands *FIRE*, and follows the target by turning the disc crank. The assistant starts the stop watch at the command *FIRE* and calls "halt" at the expiration of the time of flight. The battery commander ceases tracking and the assistant records the reading of the instrument.

The difference between this reading and the azimuth of the set-forward point as determined from the plotting board is the error in prediction.

*Example.*—Time of flight, 46 $\frac{2}{3}$  seconds; azimuth of predicted point, 217.40°; azimuth of set-forward point, 214.49°; reading of the azimuth instrument, 214.59°; error in prediction, 0.10°.

Records of these tests will be kept and the results will be published to the battery command.

#### IV. TARGET PRACTICE

##### PRECAUTIONS FOR SAFETY

233. Powder marked for one caliber or piece will not be used for any other caliber or piece of different chamber capacity.

238. When service ammunition is fired from guns (or mortars) above 4.7" in caliber, or when blank ammunition is fired from guns (or mortars) of any caliber, the powder chamber will be sponged and the mushroom head wiped off after each round and before loading for the next round, in order to insure the extinguishment of all sparks and the removal of smouldering fragments. The sponge and cloth used for this purpose will be dipped in liquid for sponging and the surplus liquid will be removed from them before they are used.

240. When firing, officers and men will be advised to place the authorized ear protectors, cotton, or small pieces of waste in their ears, but they will not be permitted to place the finger tips in their ears.

242. In case of a misfire in artillery practice the primer will not be removed and a new one inserted for at least ten minutes; during the interval, the piece will be laid on some portion of the field of fire where its discharge will not endanger shipping.

243. If firing by electricity, the circuit will be broken before the primer is removed. When using fixed ammunition and percussion primers, a second trial of the primer will be made if the firing device can be cocked by hand without opening the breech, but if this also fails, the breech will not be opened and a new cartridge substituted within ten minutes. If it is found necessary to open the breech when using obturating primers, the vent will be examined and cleared if necessary and the rear section of the powder charge will be pulled a little to the rear so that the mushroom head will push it to its place; the breech will be closed, and another primer will be tried.

244. At the command *CEASE FIRING*, lanyards will be detached. If using electric primers, the circuit will be broken. With rapid-fire guns using metallic cartridge cases, the breech will be opened. If firing is not to be resumed, fixed ammunition and separate powder charges will be withdrawn. Projectiles not loaded and fused will be driven back and withdrawn. Separate projectiles loaded and fused will be left in the gun until a favorable time to fire them; on no account will an attempt be made to drive them back.

#### SERVICE PRACTICE

235. Projectiles will be cleaned carefully before being inserted in the bore, lubricant will be removed, and the bourrelets will be freed of paint.

236. Immediately after a piece is fired, the breech will be opened and the primer will be removed.

237. Care will be taken to prevent injury to the gas-check seat and to keep it clean. If any residue from the priming charge drops from the obturator into the gas-check seat or the breech recess it will be wiped off.

239. Immediately after firing, the piece and accessories will be inspected by the battery commander and a report on their condition will be made by him (through the fire and fort commanders) to the coast defense commander. The bores of pieces will be washed clean with water, dried and oiled. The breechblocks will be dismantled, and all parts cleaned and oiled.

#### V. CARE OF MATERIAL

412. Coast defense structures, and the grounds surrounding them whose limits are prescribed by fort commanders, will be kept in proper police.

413. All open drains or gutters will be carefully swept at least once a week, and the sweepings so disposed of that they will not be carried back by wind and water.

414. Under no circumstances will drains, gutters, sumps, counter-weight wells, etc., be used as places of deposit for sweepings, waste, rags, and other rubbish. Drains and sumps will be inspected weekly, and will be kept in good order. Water fixtures will be inspected weekly, and leaky fixtures will be promptly repaired to avoid waste of water and possible damage.

421. The ammunition-service apparatus (trolleys, motors, and hoists) will be operated at least once each week, and the different working parts (pulleys, journals, etc.) will be kept clean and lubricated. Special care will be exercised in operating the motor starter and in preventing the jamming of any part of the hoists; also in the handling of projectiles at the receiving and delivery tables. The Hodges ammunition hoist is not designed and must not be used for lowering projectiles, either by motor or by hand power. The Taylor-Raymond ammunition hoist may be used with safety to lower projectiles by hand power, provided care be exercised and the hoist operated slowly; but the hoist must not be used to lower projectiles by motor power. Where emplacements are provided with cranes these will be used in preference to the Taylor-Raymond hoist for lowering projectiles.

For care of hoists, see Engineer Mimeographs, Nos. 46 and 137, and supplements.

423. *Oils* (see Ordnance Pamphlet No. 1869).—The important oils and lubricants supplied and uses therefor are shown in the following table:

Name	Use
Hydrolene-----	For filling recoil cylinders.
Kerosene-----	For cleaning purposes only, especially recoil cylinders.
Light slushing-----	For the bore, and for the bright parts of guns and carriages, when they are to remain unused for a considerable time.
Engine-----	For bright parts of guns and carriages when in daily use. For lubricating purposes where oil holes or plugs are provided.
No. 4½ Lubricant-----	For filling grease cups of heavy bearings.
Turpentine-----	For thinning paint.
Clock-----	For bearings of sights, position finders, etc.
Graphite-----	For use on heavy bearings in connection with 4½ lubricant, proportion 5% graphite to 95% lubricant <i>by volume</i> . Also for use on gas-check pads, proportion 50% graphite and 50% lubricant <i>by weight</i> .

Oils will be kept in closed receptacles, free from contamination, and will not be used a second time unless strained carefully. Discoloration does not in itself affect the serviceability of oils.

440. After firing, the powder residue will be removed by using the sponges well saturated with water. The sponges will be covered with sufficient burlap to make them a snug fit and insure reaching the bottoms of the rifling grooves. Flushing the bore with a hose immediately after firing facilitates cleaning.

441. The habitual position of guns on disappearing carriages will be "from battery." Guns on barbette carriages will be given an elevation of 5°.

442. All mortars (except model 1908) will be elevated habitually so that their axis will be parallel to the piston rod. The breech cover will be left off and the translating roller will be left in place. At forts where the sand blows into the breech mechanism and at all forts during the cold season where snow and ice may collect and form around the breech mechanism, the mortar will be kept elevated about 5° with the breech cover on. Model 1908 mortars will be kept elevated about 5° with the breech cover on.

443. *Care of carriages.*—When in use, all bearing parts will be cleaned and lubricated thoroughly. In all carriages, special attention will be given to the lubrication of gun trunnions, rollers, pintle surfaces, sliding surfaces, elevating, loading, and traversing mechanisms, including the teeth of all gears. On disappearing carriages, the following parts will be lubricated also: Gun-lever axle bearings, crosshead pins, tripping and retracting mechanisms, elevating rack and band trunnions, and crosshead guides.

Oil holes where provided will be cleaned out frequently to keep them free from sand and grit, and kept closed habitually by the screw plugs or covers provided, except during oiling.

*Before oiling at any oil hole, wipe off carefully any dirt or grit near the opening that might be carried down into the bearing by the oil.*

444. Compression grease cups will be filled with No. 4½ lubricant. The caps will then be screwed down on the cup until the spring rod projects about 0.25 inches above the top of the cap. This adjustment will be made from day to day, as required to maintain about this projection for the rod.

445. Care will be exercised that no water is allowed to enter the recoil cylinders when they are filled with oil or at any other time, for this will cause rusting of the interior of the cylinders, and in cold weather, it may freeze and burst the equalizing pipes or other parts of the recoil system.

448. All motors installed on gun carriages will be operated at least once each week if practicable for such length of time as will insure that they are in working order. When exposed to excessive moisture they will be operated for such further length of time as may be necessary to prevent accumulation of moisture in the motor cases.

450. On all seacoast gun carriages special care will be exercised to insure that bolts passing into hydraulic cylinders are tight at all times.

458. *Examination of the breech mechanism of mounted guns.*—The breech mechanism of mounted guns will be operated at least once each week, when practicable, and such parts of it as need cleaning will receive proper attention. If necessary, the tray will be removed in order to clean the worm, worm shaft, the spiral gear, and their recesses.

459. The mechanism will be oiled frequently, especially the filling-in disk, the worm shaft, ball bearings, and the hinge pin; engine oil is issued for this purpose. A mixture of 4½ lubricant and graphite is used on translating rollers. Special care will be taken to keep the primer seats clean and well oiled. Neglect of this permits rust, the removal of which enlarges the seat sufficiently to cause primers to stick.

460. *Firing mechanisms.*—Firing mechanisms will not be left on any gun or mortar out of service, but will be kept dismantled in the box provided for the purpose. All parts will be kept oiled and entirely free from dust.

461. *Piling projectiles.*—Projectiles when received at a fort will be unboxed and piled on suitable skidding with points to the wall, base out, so

that they may be inspected and fused easily. Care will be taken not to injure rotating bands. Should any rotating bands be found to be deformed, the raised portions will be filed down to the general exterior contour of the band. (See pars. 569 to 574, inc.)

465. *Dummy projectiles.*—Dummy projectiles, in order to work well, require that the bands be reasonably round and of sufficient diameter to make the projectile seat at about the position in the gun originally intended, and that the springs be of full strength. A little kerosene will be poured under the rotating band before each day's drill to cut any rust which may have formed and thus insure uniform conditions from day to day. The detailed methods of caring for these projectiles, outlined in Ordnance Pamphlet 1872, will be followed.

466. *Care of \* \* \* primers.*— \* \* \*

All obturating electric and friction primer cases will be cleaned immediately after firing and turned in to the coast defense ordnance officer for shipment to an arsenal.

## VI. STORAGE AND CARE OF EXPLOSIVES

### GENERAL INSTRUCTIONS

479. All dirt, grit, and foreign material will be removed from cases before placing them in storage. In handling cases containing explosives, they will be raised, carried to the new position, and gently lowered. Rolling, sliding, or dropping cases must be avoided.

480. One of the most important requirements in the care of any explosive is absolute cleanliness in and about the place where the explosive is stored. By removing all foreign materials from a magazine, the chances of accidents are reduced. The ground around the storage place will be kept free from leaves, long grass, brush, débris, or anything which may increase the fire risks.

481. Officers charged with the receipt and storage of explosives will direct personally the work of handling the cases.

482. Cases will never be exposed to the direct rays of the sun longer than is absolutely necessary. They will be covered with a paulin or similar cover in such a way as to admit of the free circulation of air. The effect of the direct rays of the sun on a metallic case is to raise the temperature inside the case to a point considerably above that of the open air, and this temperature is maintained for a considerable time after the exposure.

483. In opening cases, implements which may produce sparks will not be used. Suitable implements are a wooden mallet, or a copper hammer with a wooden wedge or copper chisel. A hammer will be used only when necessary, and then as lightly as possible.

484. The keys of magazines and storage places will be kept in the hands of thoroughly reliable and responsible persons.

485. Whenever there is more than one kind of explosive in a storage place, but one kind will be placed in a pile, and the different kinds separated as much as possible.

486. The date of the receipt of any explosive at a fort will be marked on the outside of the container. Each separate package will be marked.

487. Only those explosives mentioned herein as being suitable for storage together will be placed in any single storage place.

488. Free circulation of dry air is most desirable in any place where explosives are stored. Cases will always be raised off the floor of the storage

place and placed on skids.

489. If a storage place is artificially heated, or from climatic conditions the temperature of the air is liable to rise above 85° F., a maximum thermometer will be suspended therein, the temperature will be watched carefully during the period of excessive heat, and the daily readings will be recorded on the proper Ordnance Department form. Should a temperature as high as 100° F. be maintained for any length of time, the place will be cooled or the explosive removed.

490. Black powder is now supplied to the service in relatively small quantities. It will never be stored with other explosives. It will be kept dry, and on account of the danger of explosion by ignition will be protected thoroughly from all fire risks.

491. Matches and unauthorized lights will not be permitted in any magazine.

492. No loose explosive will be permitted in any building, except such as is being used actually in preparing charges.

493. Empty ammunition cases will never be stored with filled cases.

494. A copy of these instructions will be found in a convenient place in every magazine containing explosive, for the information and guidance of all concerned.

#### EXPLOSIVE D

##### *Package*

513. Explosive D is at present contained in double paper bags containing about 100 to 125 pounds of explosive. These bags are inclosed either in the standard cartridge storage cases or in strongly hooped wooden barrels painted inside with ruberine or other authorized paint. That manufactured in future will probably be packed in boxes as described for trotol.

##### *Storage and Care*

514. This explosive will be stored in a perfectly dry place, preferably in a magazine, as it has a slight tendency to absorb moisture. If it is impracticable to store in a magazine, the explosive may be stored in the dryest place available where it is protected thoroughly from all fire risks.

515. The barrels will be stored on end, marked end uppermost.

516. No cards or other material will be tacked on the barrel.

517. No nails will be driven in the barrel.

518. If from any cause the barrels of explosive are wet and there is a reasonable assurance that the interior has become wet, a barrel will be selected and opened. If the interior is wet, a full report of the circumstances will be made to the War Department. If the interior is dry, the barrel will be reheaded carefully and all barrels will be dried in the open air out of the direct rays of the sun.

519. Explosive D may be stored with wet gun cotton (15 per cent water based on dry weight of explosive), dynamite and trotol.

##### *Inspection of Forts*

520. No technical inspection of this explosive will be made at forts except by the Ordnance Department. Inspection at forts will ordinarily be limited to seeing that the rules for storage and care are strictly observed.

521. Barrels will not be opened for the purpose of inspecting the contents, except as indicated above.

522. If any barrel shows signs of drying out or opening at the staves or head, all barrels will be given a coat of ruberine or other authorized paint.

FUSES AND PRIMERS

*Package*

523. Fuses and primers are packed in hermetically sealed metallic boxes, inclosed in suitable wooden containers. These boxes will not be opened until the fuses and primers are required for use.

*Storage and Care*

524. Cases of fuses and primers may be stored in any place which is available, provided it is cool, dry, secure from entrance by unauthorized persons, and not subjected to a temperature greater than 100°F.

525. All boxes containing fuses will be marked with metal labels, obtained from the Ordnance Department, clearly indicating the projectiles to which the fuses are assigned.

526. Under no circumstances will fuses and primers be stored with other explosives, except the commercial detonators used in submarine mines.

527. Fuses will not be disassembled for any purpose. Such action by inexperienced persons is liable to result in explosion.

*Inspection*

528. The inspection of this class of explosives will be limited to seeing that the requirements of storage and care are observed strictly.

SMOKELESS POWDER

*Package*

553. Powder charges are now supplied to forts in hermetically sealed cases and will be opened only in accordance with War Deparment instructions.

*Storage and Care*

554. Smokeless powder will be stored in the driest available magazines. So long as the container remains sealed, the only effect of water is to cause unusual deterioration of the case.

555. No magazine in which the temperature of the air rises above 95°F. will be used for the storage of smokeless powder.

556. Powder storage cases containing propelling charges will normally be piled on end with skids under the first tier and each succeeding tier. This arrangement may be departed from in case special facilities for piling the cases in some other manner are provided or in case the length of the storage case is so great relative to the diameter that there is danger of tiers falling down. If cases are piled on the side for any reason, particular care should be taken to separate them by skids rounded out to fit the contour of the case, as experience has shown that the piling of cases on their sides, either without skids or with ordinary skids, has a tendency to break the seals of the cases, causing them to leak.

557. Notwithstanding the great care taken in sealing storage cases it is almost impossible to prevent some slight escape of volatiles, therefore a slight odor of ether in a magazine does not indicate deterioration. However, if the ether odor is persistently strong, it indicates a leaky storage case, which will be found by a process of elimination.

558. Testing sets are issued to each coast defense command for use in testing containers intended to be kept sealed air tight. When a leaky case

is found or the seal of a storage case of powder discovered to have been accidentally broken, the container will be securely sealed without delay, unless the container is badly damaged, the powder believed to have been wet, or there are other unusual circumstances, in which case report will be made to the armament officer.

#### *Inspection by the Ordnance Department*

559. Samples of each lot of smokeless powder issued to the service are preserved in the laboratory of the Ordnance Department for chemical test. These retained samples are subjected regularly to technical inspection and test by that department to determine their condition as to stability. Should any lot show deterioration, the change is discovered by such inspection and the entire lot recalled from forts where it is stored.

#### *Inspection of Forts*

560. With each lot of powder supplied to a fort there is furnished a ground-glass-stoppered bottle containing a sample of the particular lot of powder. This bottle will be stored in the magazine with the corresponding lot of powder. The object of preserving this sample bottle in the magazine is to enable the responsible officer to keep his powder under regular observation.

561. A strip of dry tenth-normal methyl violet paper will be kept in each sample bottle at all times. The paper gradually loses its color in the presence of oxides of nitrogen as given off by decomposing smokeless powder. The time of test is the number of days required for the paper to lose all color and become entirely white.

562. A fresh strip of test paper will be inserted in the bottle every 30 days and will have entered on it in pencil the date when inserted. If desired, old strips may be left in the bottle for 30 extra days. All strips will be examined from time to time to detect change of color. The examination will be made without removing the stopper, except when the test paper is to be inserted or removed. The bottle will never be left open longer than is absolutely necessary, since the absorption of moisture and loss of volatiles due to exposure to the atmosphere affect the powder, while the escape of nitrous fumes that may have formed in the bottle delays the completion of the test. A perfectly stable powder will give a test of 60 days or more, but a test of 30 days indicates that the stability is reasonably satisfactory. If any sample causes the paper to turn completely white in 30 days or less, a report will be submitted by the coast defense commander, giving the data indicated on the blank form provided for that purpose.

563. Methyl violet paper is not affected by diffused light or ordinary handling, but will not be exposed to direct sunlight nor soiled by careless handling. Care will be taken not to handle the sample powder grains with moist fingers or to otherwise contaminate them.

\* \* \* \* \*

#### PROJECTILES, FILLED AND FUSED

##### *Storage and Care*

569. These projectiles will be stored in the magazines provided for them, piled, and painted as required by existing orders.

570. They will be kept dry as possible and free from rust.

571. While premature explosions are not expected, projectiles filled and fused will be handled with great care.

*Inspection*

572. On account of the nature of the envelope, no inspection of the explosive is possible. The inspection of the projectiles will be limited to seeing that the requirements of "Storage and Care" are observed strictly.

**PROJECTILES, FILLED BUT NOT FUSED**

573. The fuse hole plugs should be set up fairly tight to exclude moisture. Fuse seats should not be formed unless it is actually intended to insert fuses. No danger from handling is to be expected, but care will be taken. The necessary fuses, base covers, etc., required to complete their preparation for service should be on hand at all times in boxes properly marked for identification.

*Inspection*

574. As prescribed for projectiles, filled and fused.

**FIXED AMMUNITION**

*Storage and Care*

575. Fixed ammunition for small arms or for cannon will preferably not be stored in the same magazine with other explosives. If the magazine is damp, the boxes will be piled on skids with strips between tiers and a space between boxes in a tier to permit the free circulation of air around the boxes.

*Inspection*

576. The inspection at forts will be limited to seeing that the requirements for its storage and care are observed strictly.

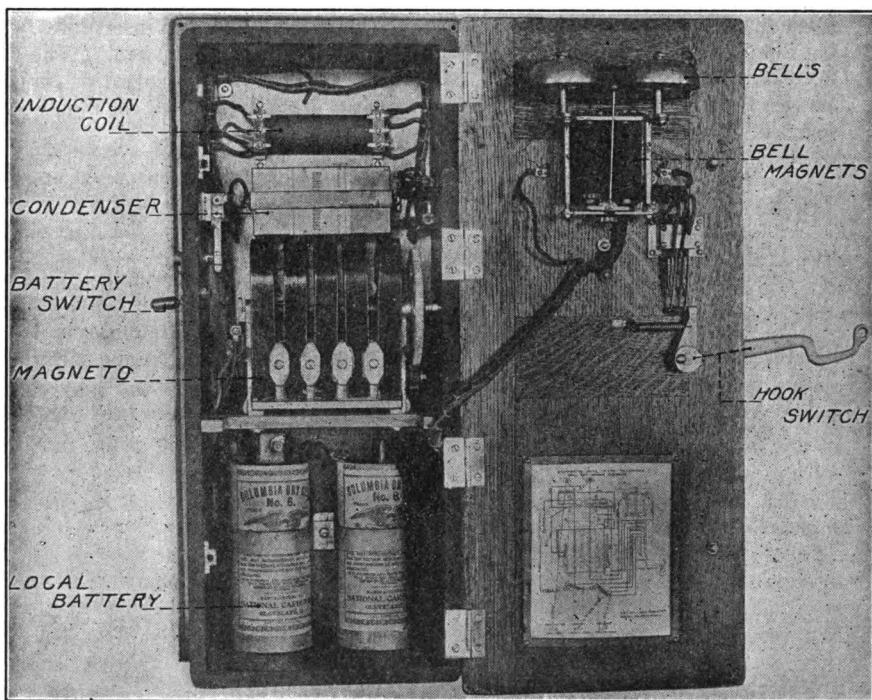
## APPENDIX "C"

### THE TELEPHONE\*

#### THE INSTRUMENT

Q. What is the telephone?

A. A telephone is an instrument by means of which a sound produced at one end of a wire is reproduced at the other end.



COMPOSITE ARTILLERY TYPE TELEPHONE

Q. What two types of telephones are used in the Coast Artillery service?

A. The "composite artillery type" and the "common-battery artillery type."

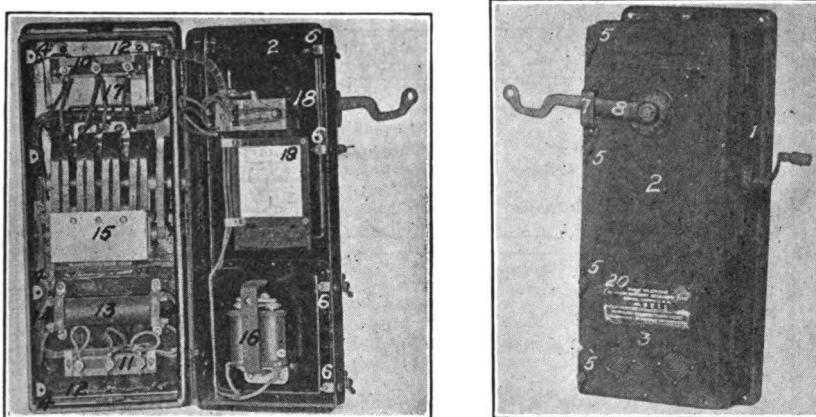
Q. What is the chief difference between the two types?

A. In the composite type use may be made of either a common or a local battery; while in the common-battery type only a common battery is used.

This information about the telephone is not now required in the gunners' examination, but it is thought that it is sufficiently valuable to the enlisted man to warrant its insertion as an Appendix.

Q. What are the two classes of telephone "sets" in artillery work, and how are they used?

A. "Auxiliary sets" and "talking sets," so arranged that any of the talking sets can be used with any auxiliary set to make up a complete telephone. The auxiliary set contains all the local parts of the telephone proper, except the receiver and transmitter. The talking sets are the receiver and transmitter made up in different forms for different kinds of service.



COMMON-BATTERY ARTILLERY TYPE TELEPHONE

1. METAL CASE, COMPLETE.
2. METAL CASE, DOOR FOR.
3. METAL CASE, METAL PLATE FOR PROTECTING GONGS OF RINGER, COMPLETE.
4. SCREW FASTENER, INTERNALLY THREADED.
5. WING BOLT FOR FASTENING DOOR.
6. ANGLE PIECE FOR SUPPORTING WING BOLT.
7. HOOK, STOP.
8. HOOK, COMPLETE.
9. HOOK RETAINER.
10. HARD-RUBBER STRIP WITH 3 WING-NUT BINDING POSTS, LINE.
11. HARD-RUBBER STRIP WITH 3 WING-NUT BINDING POSTS, TALKING SET.
12. WING-NUT BINDING POST, COMPLETE.
13. INDUCTION COIL.
14. INDUCTION COIL, TERMINALS FOR.
15. GENERATOR.
16. RINGER.
17. CONDENSER.
18. SWITCH, HOOK, COMPLETE.
19. PLATE, CIRCUITS.
20. NAME PLATE, DIRECTION.

Q. Name the different auxiliary sets.

A. Of the composite type: wall set; *plotter's set*; battery commander's set; portable set; and gun set.

Of the common-battery type: wall set; battery commander's set; portable set; and gun set.

Q. Name the different talking sets.

A. The head set, hand set, and desk set.

Q. What supplies the energy to operate the telephone?

A. Composite type: a central storage battery located in the switchboard room; or a local battery of two dry cells located inside the telephone.

Common-battery type: a central storage battery located in the switch-board room.

Q. What other telephones obtain current from the same central storage battery?

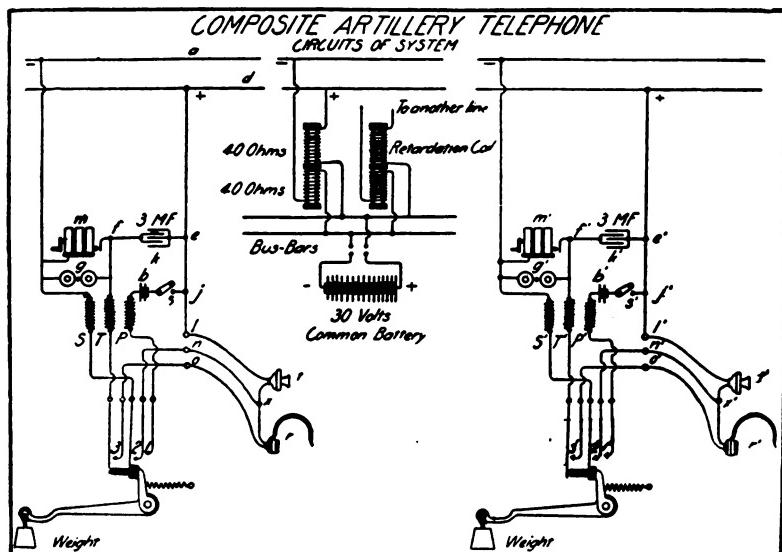
A. All the other telephones in the same fort command.

Q. What is the voltage across the terminals of the central storage battery?

A. 30 volts.

Q. Are these dry cells in the telephone now?

A. No; they are furnished only in time of war for use when the central storage battery fails.



Talking circuit: + bat., bus bar, retardation coil, + line,  
+ binding post, e, j, l, t, x, n, contact 2, S,  
- line, retardation coil, bus bar, - bat.

Hearing circuit: T, f, k, e { j, l, t, - - - - -  
+ line, e' { k', f', T', 3', o', r'  
ij', l', t' - - - - - } x, r, o, 3, T.

Ringing circuit: x', n', 2', S', - line, S, 2, n,  
m, f { g - - - - -  
(k, e, + line, e', k', f', g', - line, m) }

Q. Point out the battery switch (*of the composite type only*).

Q. What is its use?

A. It makes and breaks the local battery circuit.

Q. Upon which post should it be left?

A. Upon the post marked "Common Battery."

Q. How many circuits are there in this telephone?

A. Three: the primary, or talking circuit; the secondary, or hearing circuit; and the ringing circuit.

Q. Trace the primary circuit.

Q. What part does this circuit pass through?

A. The transmitter, the induction coil, the retardation coil, and the hook switch.

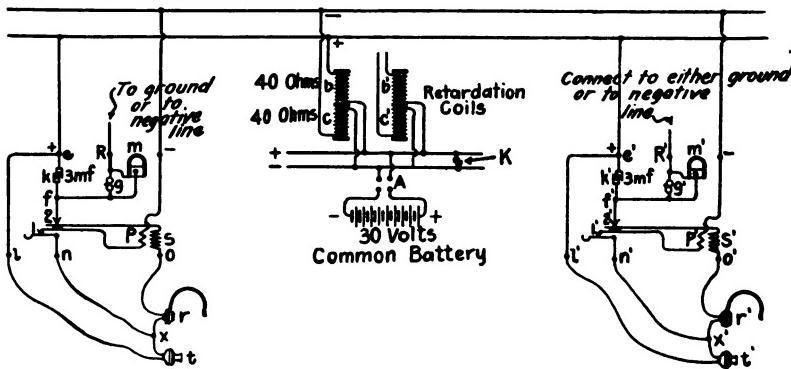
Q. Point out the transmitter.

Q. What is its function?

A. The transmitter causes the strength of the current in the primary circuit to fluctuate whenever sound waves fall upon its diaphragm.

Q. Point out the induction coil.

Q. What is its function?



COMMON BATTERY TELEPHONE  
CIRCUITS OF SYSTEM

Talking circuit:

Distant

- + bat., + bus bar, retardation coil b, + line,
- + binding post, e, l, t, x, n, hook switch contact 1,
- P, - binding post, - line, retardation coil c,
- bus bar, - bat.

Hearing circuit:

Local

- S, hook switch contact 2, f, k, e, + line,
- e', k', f', hook switch contact 2', S', o', r', x', n', hook switch contact 1', P', - binding post,
- line, - binding post, P, hook switch contact 1, n, x, r, o.

Ringing circuit:

Distant

- Magneto m, R, through ground or negative line
- R', g', f', k', e', + line, e, k, f, m.

Local

- Magneto m, through g to magneto.

A. The induction coil induces an alternating current in the hearing circuit in unison with the fluctuations in the talking circuit current.

Q. Point out the retardation coil.

Q. What is its use?

A. It prevents the talking or ringing on one line from being heard on the other lines in the fire command.

Q. Point out the hook switch.

Q. What is its use?

A. It breaks the local circuit when the receiver is up, thus preventing the storage battery from running down. It also breaks the secondary circuit and allows the bells to be rung.

- Q. Point out the line terminal posts.  
Q. Trace the local branch of the hearing circuit.  
Q. Trace the line branch of the hearing circuit.  
Q. What parts are in the hearing circuit?  
A. The receiver, the induction coil, the condenser, the transmitter and the hook-switch of both the local and distant phones.  
Q. Point out the receiver.  
Q. What is its Use?  
A. The object of the receiver is to reproduce sound waves when its coils are energized by the alternating current in the hearing circuit.  
Q. Point out the condenser.  
Q. What is its function?  
A. It prevents the direct current from the storage battery from flowing through the bell and the generator. It also makes the talking more distinct.  
Q. Trace the ringing circuit.  
Q. What parts are in the ringing circuit?  
A. The generator, the bell, and the condenser.  
Q. Point out the generator.  
Q. What is its function?  
A. By turning the generator crank, the armature is revolved and an alternating current is generated which rings the bells.  
Q. Point out the bell.  
Q. What are its functions?  
A. It rings to notify the operator that he is wanted.  
Q. Point out the terminal posts for the head set.  
Q. How can you tell which wire should be attached to each post?  
A. The wires are of different colors and the terminal posts are labeled with the corresponding colors.  
Q. What different kinds of composite artillery type telephones are there?  
A. The wall telephone, the plotter's telephone, the gun telephone, the battery commander's telephone, the desk telephone, and the portable telephone.  
Q. Tell how to open station.  
A. (a) Take the head set or retaining spring off the hook and put on the head set.  
(b) See that the connections are tight. These include the two connections to the line and three for the head set.  
(c) Lower and raise the hook. A sharp click should be heard. A slight scratching in the transmitter should be heard in the receiver.  
(d) Call the name of the distant station.  
(e) To ring up the distant station, hold the hook down and turn the generator handle. Release the handle to converse. If any hooks on the line are up, none of the distant bells will ring.  
Q. How is the station closed?  
A. Call "close station" to distant station; hang receiver on hook or attach retaining spring; wipe off both receiver and transmitter.  
Q. What care should be taken of the telephone?  
A. Never leave the station with the hook up; keep the nuts on the terminal posts tight and the cords clear of tangles; polish up the outside nickel work once a week; keep the door shut; report trouble in the talking to the station chief.

## APPENDIX "D"

### List of Ordnance Pamphlets for Reference

(Where more than one number is given in one item, the numbers and subjects are in corresponding sequence.)

Nos.	Subjects.
1872	Ammunition, seacoast artillery.
1656	
1657	} Azimuth instruments, W. & S.: 1910; 1900, and 1900 MI
1665	Breech mechanism.
1666	
1668	} Board, deflection: gun, 1905; mortar.
1669	
1672	} Board, plotting: gun and mortar; 360°, mod. 1911, mortar
1663	
1674	} Board, range, gun: Pratt, 1909.
1676	Cannon and projectiles, table, U. S. Army.
1701	Carriage, 15-pdr., barb., 1903.
1683	
1684	} Carriages, 5-inch: balanced pillar, 1896; barb., 1903.
1686-	
1688	Carriages, 6-inch: disap., L. F., 1898; disap., L. F., 1903; barb.,
1703	1901; disap., L. F., 1905; disap., L. F., 1905 MI.
1704	
1685	
1689	Carriages, 8-inch: barb., 1892; disap., L. F., 1894; disap., L. F., 1896.
1690	
1691-	Carriages, 10-inch: disap., L. F., 1894; disap., L. F., 1896; disap.,
1694	A. R. F., 1896; disap., 1901; barb., 1893.
1700	
1695-	Carriages, 12-inch: disap., L. F., 1896; disap., L. F., 1897; disap.,
1697	L. F., 1901; barb., 1892.
1702	
1712	Carriage, 14-inch, disap., L. F., 1907 and 1907 MI.
1698	
1699	
1705	Carriages, 12-inch mortar: 1891; 1896; 1896 MI; MII 1908;
1707	1896 MIII.
1709	
1706	
1708	Carriages, <i>Dummy</i> : 12-inch mortar, 1912; 15-pdr., 1912; 10-inch
1710	disap., L. F., 1912.
1727	Fuses
1763	Gun, 6-pdr., and mount.

- 1768 Gun, 3-inch saluting and mount.  
1756  
1766 } Guns, 15-pdr.: 1898; 1902; 1903.  
1772 }  
1749- } Guns, Armstrong, 4.72-inch: 40-cal.; 45-cal.; 50-cal.  
1751 }  
1765 Guns, 5 and 6-inch.  
1752 Gun, Armstrong, 6-inch.  
1803 Hydraulic jacks.  
1794 Indicator, wind component.  
1795 Instruments for fire control system: care, preservation, etc.  
1721 Loading projectiles with explosive D.  
1869 Materials for cleaning, preservation, etc.  
1820 Mortars, 12-inch.  
1868 Paints for projectiles.  
1873- } Position finders, depression: Lewis, 1898; Rafferty, B; Swasey.  
1876 } Lewis, 1907.  
1946 Prediction scale, etc.  
1738 Pressure gauge outfits.  
1881 Primers.  
1877 Projectiles, distinctive colors of.  
1905 Range-finder, Barr and Stroud, 9-ft., horizontal, self-contained.  
1952  
1955 } Sights: for cannon; 3-inch telescopic; 2-inch tel., 1906; 2-inch 1906;  
1956 } 2-inch tel., 1909.  
1958 }  
1888 Smokeless powder, etc., care of.  
1986 Subcaliber guns.  
1991 Targets.  
2000 Telescope, observation, 1908.





## APPENDIX "F"

COAST ARTILLERY  
MEMORANDUM NO. 10.

WAR DEPARTMENT,  
WASHINGTON, November 25, 1910.

The following abridged instructions for loading projectiles with Explosive D for use in instruction of gunners as contemplated in paragraphs 984 to 996, inclusive, Coast Artillery Drill Regulations, 1909, are published for the information and guidance of all concerned.

1. The service high explosive for bursting charges of projectiles for sea-coast cannon is known as Explosive D. It is very insensitive to shock and, so far as known, can not be exploded by any means incident to handling or transportation. It has been adopted as a bursting charge in steel shell and shot of calibers from the 2.95-inch to 14-inch, inclusive. In projectiles smaller in caliber than 2.95-inch a different explosive is used as a bursting charge.
2. Explosive D is far more powerful and very much less sensitive than black powder. Its insensitiveness is illustrated by the fact that it is not exploded by impact of the projectile in which inserted against the hardest steel plate unless a detonating fuze is used in the shell.
3. Explosive D can be inserted in projectiles under pressure either by a hydraulic press or by hand with suitable ramming tools. The latter method having been found practicable, and not necessitating the installation of an expensive apparatus, has been adopted. The explosive used in projectiles under 2.95-inch caliber is compressed in the projectiles by means of a hydraulic press.
4. For convenience of reference projectiles are divided into three classes—minor, medium, and major caliber. Minor caliber projectiles comprise all projectiles from the 1-pounder to the 2.38-inch, inclusive; medium caliber projectiles comprise all from the 2.95-inch to the 7-inch, inclusive, and major caliber projectiles comprise all from the 8-inch to the 16-inch, inclusive.
5. To facilitate manufacture, all steel projectiles from the 5-inch to the 16-inch, inclusive, consist of two parts, the body of the projectile and the base plug, which is threaded to screw into a correspondingly threaded seat in the body. The base plug is provided with a fuze hole suitably tapped and counterbored for the fuze.
6. Projectiles under 5-inch in caliber, except a limited number of earlier manufacture, are not provided with base plugs, the fuze alone serving to close the cavity.
7. All steel projectiles using a bursting charge of high explosive are arranged to take a base detonating fuze with the exception of a limited number of 2.95-inch mountain gun and 3-inch field gun shell, which are arranged for a point detonating fuze. All projectiles below 4.7-inch caliber will be loaded and fuzed prior to issue.
8. Projectiles loaded with Explosive D require a detonating fuze to develop the force of explosion; the ordinary percussion fuze used to ignite black powder bursting charges has not sufficient power.

9. To eliminate the danger of premature bursts, due to the powder gases of the propelling charge passing the threads of the fuze and base plug and entering the cavity of the projectile, a copper base cover is crimped into an undercut groove in the base of the projectile after the detonating fuze has been inserted.

10. Explosive D is issued in barrels containing 125 pounds of explosive, net. It should be stored in dry magazines or such other buildings as may be available for the purpose.

11. The room selected for loading projectiles with Explosive D must be cleared of all other stores and thoroughly cleaned for the purpose (*especial care being taken to keep the explosive free from lime, dirt, or other foreign material*). Dust particles of the explosive must be cleared up at the end of each day's work, and the whole room must be carefully washed out after completing the filling of the projectiles on hand or when the use of the room is to be resumed for other purposes.

12. No metallic or other paints, except those especially provided by the Ordnance Department for the purpose, will be used in connection with the loading, especially for the interior of projectiles. Lead paints are particularly objectionable, as they are liable to act upon the explosive and form compounds very sensitive to shock.

13. No fire will be allowed in the room or in proximity thereto, and no matches will be allowed in the room. In other words, every precaution will be observed to guard against the possibility of accident.

14. Detonating fuzes will be handled carefully; dropping them on hard surfaces or marring or jamming them should be avoided.

15. Disassembling detonating fuses at posts for any purpose whatever is prohibited. This prohibition is made especially to guard against the probability of accident on account of the sensitiveness of the fuzes.

16. As a rule, the fuze should be assembled in the projectile, and the base cover attached, on the day on which they are filled.

17. The projectiles prepared for service will be stored in a dry place, which must be fireproof and remote from danger of fire. The burning of a building in which these projectiles are stored would constitute a source of danger that must be avoided.

18. For unfuzed projectiles already issued to posts, the fuzes and base covers are held by the ordnance officers at the posts.

19. In loading projectiles with Explosive D their cavities are first carefully cleaned and then coated with ruberine or other authorized paint. When this has set the projectile is charged, the explosive being added in small quantities and rammed solid. The fuze seat is formed in the solid mass with suitable tools, after which the fuze is inserted and the base cover added and calked in place.

20. Projectiles charged with Explosive D, fuzed or unfuzed,\* have the whole surface in rear of the rotating band painted a deep yellow color.

BY ORDER OF THE SECRETARY OF WAR:

LEONARD WOOD,  
*Major General, Chief of Staff.*

OFFICIAL:

HENRY P. McCAIN,  
*Adjutant General.*

\*This has been modified in more recent orders. See page 14.—Editor.

## APPENDIX "G"

### U. S. MAGAZINE RIFLE

#### DESCRIPTION OF THE OPERATION OF THE PRINCIPAL PARTS

Most of the operating parts may be included under the *bolt mechanism* and *magazine mechanism*.

The bolt moves backward and forward and rotates in the well of the receiver; it carries a cartridge, either from the magazine or one placed by hand in front of it, into the chamber and supports its head when fired.

The hook of the extractor engages in the groove of the cartridge case and retains the head of the latter in the countersink of the bolt until the case is rejected.

The safety lock when turned to the left, is inoperative; when turned to the right—which can only be done when the piece is cocked—the point of the spindle enters its notch in the bolt and locks the bolt; at the same time its cam forces the cocking piece slightly to the rear, out of contact with the sear, and locks the firing pin.

The bolt mechanism operates as follows: To open the bolt, raise the handle until it comes in contact with the left side of the receiver and pull directly to the rear until the top locking lug strikes the cut off.

To close the bolt, push the handle forward until the extracting cam on the bolt bears on the extracting cam on the receiver, thereby unlocking the sleeve from the bolt, and turn the handle down. As the handle is turned down, the cams of the locking lugs bear against the locking shoulders in the receiver, and the bolt is forced slightly forward into its closed position. The piece is then ready to fire.

To pull the trigger, the finger piece must be drawn to the rear until contact with the receiver is transferred from its bearing to the heel, which gives a creep to the trigger, and then until the sear nose is withdrawn from in front of the cocking piece.

Double loading from the magazine is prevented by the extractor engaging the cartridge case as soon as it rises from the magazine and holding its head against the face of the bolt until ejected.

The piece may be cocked either by raising the bolt handle until it strikes the left side of the receiver and then immediately turning it down, or by pulling the cocking piece directly to the rear.

The opening and closing of the bolt should each be done by one continuous motion.

To charge the magazine, see that the cut-off is turned up showing on, draw the bolt fully to the rear, insert the cartridges from a clip, or from the hand, and close the bolt. To charge the magazine from a clip, place either end of a loaded clip in its seat in the receiver and, with the thumb of the right hand, press the cartridges down into the magazine until the top cartridge is caught by the right edge of the receiver. The magazine can be filled, if partially filled, by inserting cartridges one by one.

Pushing the bolt forward, after charging the magazine, ejects the clip.

When the cut-off is turned down, the magazine is *off*. The bolt can not be drawn fully back, and its front end projecting over the rear end of the upper cartridge holds it down in the magazine below the action of the bolt. The magazine mechanism then remains inoperative, and the arm can be used as a single-loader, the cartridges in the magazine being held in reserve. The arm can readily be used as a single-loader with the magazine empty.

When the cut-off is turned up, the magazine is *on*; the bolt can be drawn fully to the rear, permitting the top cartridge to rise high enough to be caught by the bolt in its forward movement. As the bolt is closed, this cartridge is pushed forward into the chamber, being held up during its passage by the pressure of those below. The last one in the magazine is held up by the follower, the rib on which directs it into the chamber.

In magazine fire, after the last cartridge has been fired and the bolt drawn fully to the rear, the follower rises and holds the bolt open to show that the magazine is empty.

#### *Precautions*

If it is desired to carry the piece cocked, with a cartridge in the chamber, the bolt mechanism should be secured by turning the safety lock to the right.

Under no circumstances should the firing pin be let down by hand on a cartridge in the chamber.

To obtain positive ejection, and to insure the bolt catching the top cartridge in magazine, when loading from the magazine, the bolt must be drawn fully to the rear in opening it.

When the bolt is closed, or slightly forward, the cut-off may be turned up or down, as desired. When the bolt is in its rearmost position, to pass from loading from the magazine to single loading, it is necessary to force the top cartridge or follower below the reach of the bolt, to push the bolt slightly forward and to turn the cut-off down, showing *off*.

In case of a misfire, it is unsafe to draw back the bolt immediately, as it may be a case of hang-fire. In such cases the piece should be cocked by drawing back the cocking piece.

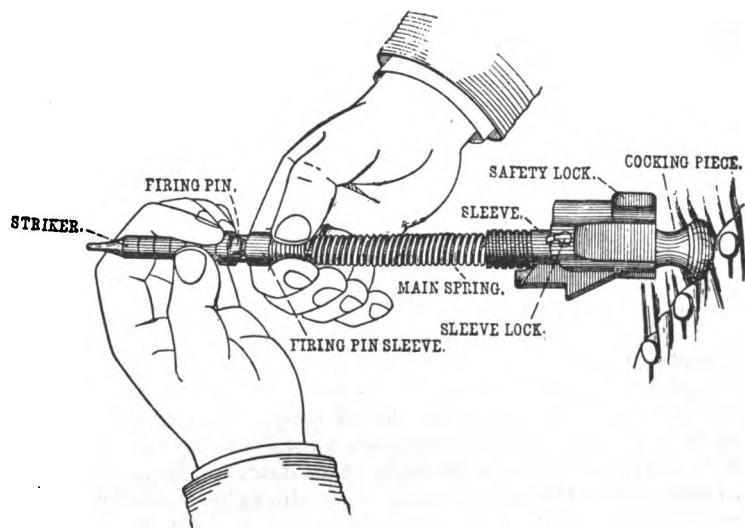
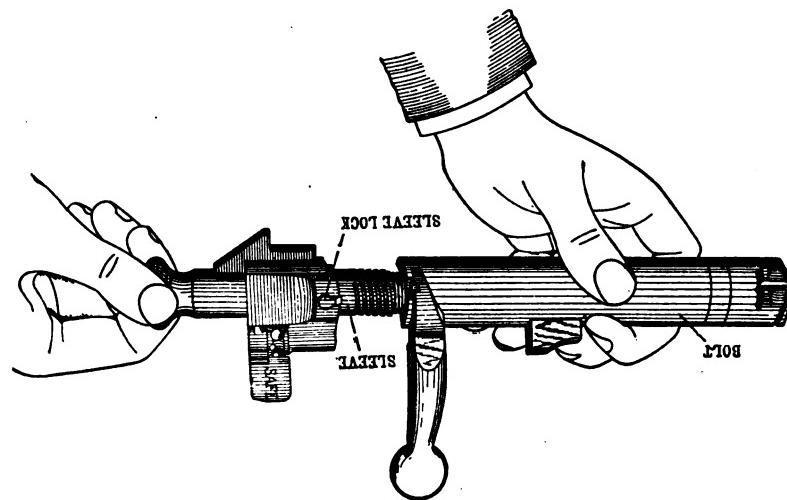
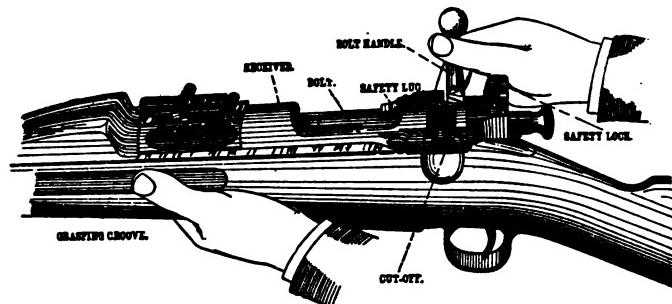
*It is essential for the proper working and preservation of all cams that they be kept lubricated.*

#### **DISMOUNTING AND ASSEMBLING BY SOLDIER**

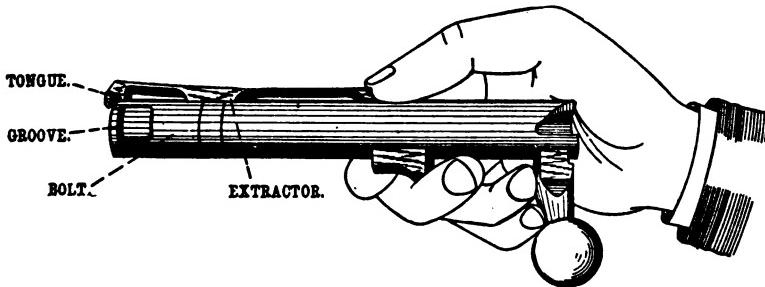
The bolt and magazine mechanism can be dismounted without removing the stock. The latter should never be done, except for making repairs, and then only by some selected and instructed man.

#### *To Dismount Bolt Mechanism*

Place the cut-off at the center notch; cock the arm and turn the safety lock to a vertical position, raise the bolt handle and draw out the bolt. Hold bolt in left hand, press sleeve lock in with thumb of right hand to unlock sleeve from bolt, and unscrew sleeve by turning to the left. Hold sleeve between forefinger and thumb of the left hand, draw cocking piece back with middle finger and thumb of right hand, turn safety lock down to the left with forefinger of the right hand, in order to allow the cocking piece to move forward in sleeve, thus partially relieving the tension of mainspring; with the cocking piece against the breast, draw back the firing pin sleeve with

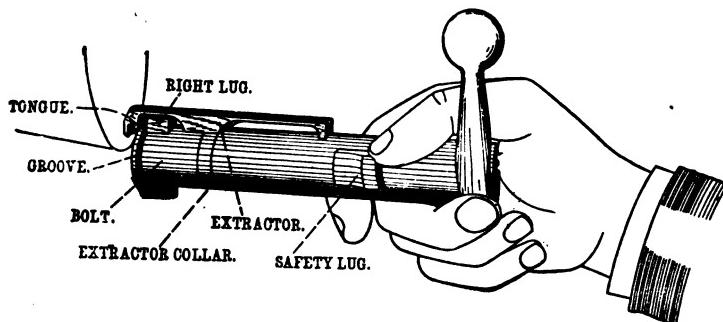


forefinger and thumb of right hand and hold it in this position while removing the striker with the left hand; remove firing pin sleeve and mainspring; pull firing pin out of sleeve; turn the extractor to the right, forcing its tongue out of its groove in the front of the bolt, and force the extractor forward and off the bolt.



*To Assemble Bolt Mechanism*

Grasp with the left hand the rear of the bolt, handle up, and turn the extractor collar with the thumb and forefinger of the right hand until its lug is on a line with the safety lug on the bolt; take the extractor in the right hand and insert the lug on the collar in the undercuts in the extractor by pushing the extractor to the rear until its tongue comes in contact with the rim on the face of the bolt (a slight pressure with the left thumb on the top of the rear part of the extractor assists in this operation); turn the extractor to the right until it is over the right lug; take the bolt in the right hand and



press the hook of the extractor against the butt plate, or some rigid object, until the tongue on the extractor enters its groove in the bolt. With the safety lock turned down to the left to permit the firing pin to enter the sleeve as far as possible, assemble the sleeve and firing pin; place the cocking piece against the breast and put on mainspring, firing pin sleeve, and striker. Hold the cocking piece between the thumb and forefinger of the left hand, and by pressing the striker point against some substance, not hard enough to injure it, force the cocking piece back until the safety lock can be turned to the vertical position with the right hand; insert the firing pin in the bolt and screw up the sleeve (by turning it to the right) until the sleeve lock enters its notch on the bolt. See that the cut-off is at the center notch;

under floor plate in the fingers of the left hand, thumb extending over the left side of the receiver; take bolt in right hand with safety lock in a vertical position and safety lug up; press rear end of follower down with left thumb and push bolt into the receiver; lower bolt handle; turn safety lock and cut-off down to the left with right hand.

*To Dismount Magazine Mechanism*

With the bullet end of a cartridge press on the floor plate catch (through the hole in the floor plate), at the same time drawing the bullet to the rear; this releases the floor plate. Raise the rear end of the first limb of the magazine spring high enough to clear the lug on the floor plate and draw it out of its mortise; proceed in the same manner to remove the follower.

To assemble magazine spring and follower to floor plate, reverse operation of dismounting.

Insert the follower and magazine spring in the magazine, place the tenon on the front end of the floor plate in its recess in the magazine, then place the lug on the rear end of the floor plate in its slot in the guard, and press the rear end of the floor plate forward and inward at the same time, forcing the floor plate into its seat in the guard.

CLEANING AND CARE OF THE ARM

As the bore of the rifle is manufactured with great care in order that a high degree of accuracy may be obtained, it should be carefully cared for. The residuum from smokeless powder tends to corrode the bore and should therefore be removed as soon after firing as practicable. The following method has been practiced at the Springfield Armory for a number of years with good results: Using the cleaning rod and small patches of cloth (preferably canton flannel), clean the bore thoroughly with patches soaked in saturated solution of soda and water. Then thoroughly dry the bore and remove the soda solution by the use of dry patches, and finally oil the bore with patches soaked in cosmic oil. Twenty-four hours after this first cleaning, the bore should be again cleaned as described above, as it has been found that the powder gases are probably forced into the texture of the steel and will, if the second cleaning is not resorted to, cause rusting, no matter how thoroughly the bore may have been cleaned at first.

If, however, a cleaning rod is not at hand, the barrel should be cleaned as thoroughly as possible by means of the thong brush and rags, and oiled as above. To clean or oil the bore with rags, the thong brush is unscrewed, the rag placed in the rag slot of the thong tip and drawn from the muzzle toward the breech.

If gas escapes at the base of the cartridge, it will probably enter the well of the bolt through the striker hole. In this case the bolt mechanism must be dismounted and the parts and well of the bolt thoroughly cleaned.

Before assembling the bolt mechanism, the firing pin, the barrel of the sleeve, the body of the striker, the well bolt, and all cams should be lightly oiled.

Many of the parts can generally be cleaned with dry rags. All parts after cleaning should be wiped with an oil rag. The best method of applying oil is to rub with a piece of cotton cloth upon which a few drops of oil have been placed, thereby avoiding the use of an unnecessary amount of oil; this method will, even in the absence of the oiler, serve for the cams

and bearings, which should be kept continually oiled. Any part that may appear to move hard can generally be freed by the use of a little oil.

The stock and hand guard may be coated with raw linseed oil and polished by rubbing with the hand.

Sperm oil only should be used for lubricating metallic bearing and contact surfaces.

For the chamber and bore, only cosmoline or cosmic should be used. This should also be applied to all metallic surfaces, to prevent rusting when arms are stored or when not used for an appreciable length of time.

**INSTRUCTIONS FOR CLEANING FROM "SMALL ARMS FIRING MANUAL"**  
(PAR. 134)

After firing, the bore of the rifle is covered with fouling. This is of two kinds, a black deposit covering the entire bore, caused by the burning powder and easily removed with rags, and a metallic fouling, caused by particles of the metal jacket of the bullet adhering to the barrel, which can be removed only by the use of ammonia solution.

The powder fouling must be removed first. Then the metallic fouling can be seen in patches on the lands.

To remove the powder fouling use a cleaning rod long enough to clean from the breech; Hoppe's Powder Solvent No. 9; rags, about  $1\frac{1}{4}$  inches square, of thin flannel or any other soft material.

A cleaning rack should be provided for every barrack.

Rifles should always be cleaned from the breech, thus avoiding any possible injury to the muzzle. Any injury to the rifling at the muzzle will affect the shooting adversely. If the bore for a length of 6 inches at the muzzle is perfect, a minor injury near the chamber will have little effect on the accuracy of the rifle.

The rifle should be cleaned as soon as the firing for the day is completed. The fouling is easier to remove then, and if left longer it will corrode the barrel.

Take a couple of rags soaked in No. 9 and run them through the barrel until they have removed all the powder fouling; run clean rags through to dry the barrel; clean with ammonia solution as directed and finish by wiping out with a greased rag or a clean rag soaked in No. 9. For grease, use vaseline, cosmic, or "3 in 1" oil. After the barrel is cleaned, wipe out the chamber, the cams, bolt, and all visible working parts. Occasionally clean out the magazine and wipe off magazine spring, then wipe all working parts with a greased rag.

After cleaning the working parts, wipe off stock and outside of barrel with oiled rag.

Before firing again, wipe all oil out of barrel, but leave chamber and working parts slightly oily. This will prevent shells binding in chamber and will make parts work easier. Wipe all oil from outside of barrel and stock.

To remove metallic fouling, use ammonia solution. This is made as follows: Take ammonia persulphate, 1 ounce; ammonium carbonate, 200 grains; ammonia (28 per cent), 6 ounces; water, 4 ounces. One rounded tablespoonful equals 1 ounce of persulphate or 200 grains of carbonate.

Powder the persulphate and carbonate separately. Desolve the persulphate in the ammonia and the carbonate in the water and then pour the mixture in a strong bottle, and cork. If mixed in this manner, it may be used in an hour.

**To use.**—After the barrel has been cleaned with No 9 and wiped dry, cork up breech with a small cork, put a piece of rubber tubing about an inch long on the muzzle, and fill the barrel with the solution. It will boil up instantly with a white foam, very slightly blue. Let the solution stay in the barrel not more than 10 minutes and then pour out. If there was any metal fouling, the solution will be dark blue.

Fill the barrel with water to remove any remaining ammonia, pour out, and then remove the cork and rubber tube, wipe barrel perfectly dry, and then rub with oiled rag.

Care should be used in mixing and using this solution, for if improperly mixed or used it will injure the rifle. If the solution, after being used, is brown, it is bad and should be thrown away. The proportions of persulphate and carbonate should be the same in bulk. Too much persulphate will injure the barrel.

Keep the barrel filled. If the solution evaporates, it will leave a deposit of persulphate on the surface of the bore and will injure it.

An experienced noncommissioned officer should mix the solution and supervise its use.

Care should be taken not to spill the solution on the barrel or in the mechanism.

#### APPENDAGES AND ACCESSORIES

The oiler and thong case are carried in the butt of the stock. In one section is carried a small supply of sperm oil, and in the other the thong and brush used for cleaning the bore of the rifle.

The cap on the oil section is fitted with a wire, flattened at its point, which reaches to the bottom of the section and is used for applying oil, a drop or more at a time. *The oil is only for the lubrication of the working parts.* The cap is also provided with a leather washer to prevent leakage. The cap on the thong section has a leather pad on its outer surface, which prevents the noise that would result from the oiler striking the butt plate cap. The oiler should always be inserted in the stock so that the leather-tipped cap will be next to the butt plate cap.

The cleaning rod is made of brass rod 0.25 inch in diameter, and of sufficient length to extend through the barrel.

The front sight cover is made of sheet steel and pressed into shape. It is then case-hardened, giving it sufficient spring to cause it to hug closely the barrel and front sight stud, thereby retaining its position on the barrel. It is used to protect the sight and should be kept in place at all times. During firing, it may be removed, if desired.

The screwdriver has a large blade, a small blade, a spur, a pin, and a rivet. The large blade should be used for the large butt plate screw, the butt plate spring screw, and the guard screws; the small blade for all other screws, except the cut-off screw, for which the spur should be used. The pin serves as a drift in removing the butt plate cap, ejector, floor plate catch, sear and trigger pins, and the lower band spring. No other screwdriver should be used in the repair of the rifle.

#### AMMUNITION FOR U. S. MAGAZINE RIFLE, MODEL OF 1903

**Ball cartridge.**—The caliber .30 ball cartridge consists of the case, primer, charge of smokeless powder, and bullet. The case is of cartridge brass. The head of the case is grooved to provide for extraction of cartridge from

the chamber of the rifle. The initials of the place of manufacture, the number of the month, and the year of its fabrication are stamped on the head of case.

The primer consists of the cup, percussion composition, disk of shellacked paper, and anvil. The charge is of composition very similar to the powders used as propelling charges in field and seacoast guns. The normal charge weighs from 47 to 50 grains, varying with the lot of powder used. The bullet has a core of lead and tin composition inclosed in a jacket of cupronickel. It weighs 150 grains, and the point is much sharper and offers less resistance to the air than that of any previous model in the United States service. The standard muzzle velocity of this ammunition in the rifle is 2700 feet per second. The cartridge complete weighs about 395.5 grains, its weight varying slightly with variations in the weight of the powder charge. Five cartridges are packed in a clip. The clip body can be used a number of times, but the springs only once.

The gallery practice and dummy clip is provided with a strong bronze spring without tongues. Sixty ball cartridges in twelve clips are packed in a bandoleer. The bandoleer is made of olive drab cloth and contains six pockets, each holding two clips. The clips can be readily taken out by forcing back the fold of the pocket. The bandoleer is provided with a shoulder strap of olive drab webbing by which it is carried over the shoulder, and a safety pin is provided to afford an adjustment of its length to suit the convenience of the soldier. The bandoleer, with cartridges, weighs about 3.88 pounds.

*Blank cartridge.*—The *blank* cartridge, model of 1906, differs from the *ball* cartridge in the charge of powder and in the bullet, and in the fact that the case is tinned. The bullet is of paper, hollow, and contains a charge of smokeless powder, which insures the breacking up of the bullet on leaving the bore. A coating of paraffin on the outside of the bullet prevents the absorption of moisture by the paper. Model 1909 has no paper bullet.

*Dummy cartridge.*—The case of the dummy cartridge is tinned and provided with six longitudinal corrugations, also three circular holes in the corrugated portion. The tinning, corrugations, and holes afford unmistakable means for distinguishing the dummy from the ball cartridge, both by sight and touch. The bullet is the same as in the ball cartridge. The dummy primer has cup and anvil, but no percussion composition.

*Guard cartridge.*—This cartridge differs from the ball cartridge in the charge of powder and in the fact that second-class bullets having slight imperfections are used. Five grooves encircle the body of the case about the middle (old style), or six short straight grooves encircle it at the shoulder (new style), affording means for distinguishing it from the ball cartridge by either sight or touch. The charge gives a muzzle velocity of 1200 feet per second. This cartridge gives good results at 100 yards and has sufficient accuracy for use at 150 and 200 yards. The range of 100 yards requires a sight elevation of 450 yards, and ranges of 200 and 300 yards require elevations of 650 and 850 yards, respectively.

#### PARAGRAPH 292, ARMY REGULATIONS, 1913

"Enlisted men will not take their arms apart, except by permission of a commissioned officer under proper supervision, and only in the manner prescribed in the descriptive pamphlet of the arm issued by the Ordnance Department. The polishing of blued or browned parts of small arms, rebluing or rebrowning, putting any portion of an arm in a fire, or removing a receiver

from a barrel, is prohibited. The mutilation of any part by filing or otherwise, and attempts to beautify or change the finish, are prohibited. Pieces will be unloaded before being taken to quarters or tents, and as soon as the men using them are relieved from duty, unless otherwise ordered. The use of tompons in small arms is forbidden. The prohibition in this paragraph of attempts to beautify or change the finish of arms in the hands of enlisted men is not construed as forbidding the application of raw linseed oil to the wood parts of the arms. This oil is considered necessary for the preservation of the wood, and it may be used for such polishing as can be given by rubbing in one or more coats when necessary. The use of raw linseed oil only will be allowed for re-dressing, and the application for such purpose of any kind of wax or varnish, including heelball, is strictly prohibited."

## APPENDIX "H"

### DEFLECTION RECORDER'S BOARD, RANGE BOARD, AND TIME-RANGE BOARD

(Numbers refer to paragraphs in the 1914 Drill Regulations.)

#### DEFLECTION RECORDER'S BOARD

387. The deflection recorder's board consists of a plain blackboard about two feet square. It is placed on the wall of the emplacement where it can be seen by the gun pointer. The deflection recorder wears a telephone head set in parallel with that of the range recorder.

The deflection recorder records the last deflection received when it differs from the last one recorded, erasing the latter. The record is written in large heavy numbers about eight inches high.

#### RANGE BOARD FOR GUNS OF MAJOR AND INTERMEDIATE ARMAMENT

(See First Class, (b) Duties in the Plotting Room, for illustration)

394. *Description.*—The range correction board is a mechanical computing device used in determining the corrected range to be transmitted to the gun emplacements. It consists of a *box*, a *chart frame*, a range-correction *chart*, a *marker system*, a *correction ruler*, *chains*, *sprokets*, and *counterweight*.

The *chart frame* is secured within and fills the interior of the *box*. The range correction *chart* is pasted on, with its range scale perpendicular to the bottom edge of the *chart frame*.

The range correction *chart* is provided with four sets of *correction curves* designated "atmosphere," "velocity," "tide," and "wind," a vertical range scale on each edge of the chart, horizontal range lines and data for accuracy tests. The *curves* are drawn to give the range correction for every 2 per cent variation in the density of the air, for every 10 f.s. M.V., for every 5 feet of tide, and for every 10-mile range component of wind. The red line on the chart is a line of no correction and is called the *normal*. To avoid liability of error, *reference numbers* are used, instead of two sets of numbers with the plus and minus signs. The horizontal scale of the *chart* is 200 yards to the inch.

The *marker system* consists of a *bar* on which slide *markers* used to indicate the *correction curve* to be used in each set. The *bar* is attached to the *box* near its top.

The *correction ruler* consists of two *range scales*—one *fixed*, the other *movable*—both scales 400 yds. to the inch; two *bars*—one *fixed*, the other *movable*; four *movable pointers* with *clamps*, one for each set of *correction curves*; a *gear system* for operating the *movable parts*; two *fixed indexes* and a *movable index* with *reading glass*.

The *clamp* for the *pointers* is so designed that each *pointer* is clamped independently of the others, either to the *movable bar*, to the *fixed bar*, or to both *bars* simultaneously. Any *pointer* clamped to both *bars*, locks the whole system and is called the *locking pointer*. To expedite operation,

outside *pointers* are alternated as the *locking pointer*. All other *pointers* are clamped to the *fixed bar*. The provision for locking to both bars serves two purposes: first, to provide against shifting the pointer when passing from one clamped position to the other; and second, to prevent the system from getting out of adjustment.

The *gear system* is designed to move by turning the *knob*, the pointers carried on the *movable bar* and the *movable range scale* simultaneously, the former moving twice the distance of the latter. The displacement of the latter records the aggregate motion of the *pointers*. The *knob* must never be turned, except when adjusting, while all four *pointers* are clamped to the *fixed bar*.

One end of each sprocket *chain* is attached to the *counterweight*. Both *chains* pass up through the middle of the top of the *box*, separate, and each passes over two *sprocket wheels*, thence down through the top of the *box*, and each is attached at its other end to an end of the *correction ruler*. The *ruler* can be moved up or down immediately in front of the *correction chart* and will remain at any position to which it is set.

*Adjustments.*—There are two adjustments for the range board.

First: Vertical adjustment. With the adjusting *screw* on one of the sprocket *chains*, set the two *fixed indexes* at the same range on the vertical scales on the *correction chart*.

Second: Horizontal adjustment. Clamp the *locking pointer* to the *movable bar*. Turn the knob of the *gear system* until the *pointer* is exactly opposite the *normal* of its set of *correction curves*. Clamp this *pointer* to the *fixed bar*. In like manner set each of the other *pointers* to the *normal* of its *correction curves* and clamp to the *fixed bar*. When all four *pointers* are at their *normals* and clamped to the *fixed bar*, turn the *knob* until the *movable index* indicates the same range on both *movable* and *fixed range scales*. Clamp one outside *pointer* only to both *movable* and *fixed bars*, locking the system.

*Operation.*—Set each *marker* at its proper *correction curve*. Set the *movable index* at the range to the set-forward point on the *fixed range scale*. Set the *fixed indexes* of the *correction ruler* at the range of the set-forward point on both *vertical range scales* of the *correction chart*. Clamp the *locking pointer* to the *movable bar*, and by means of the *knob*, set this *pointer* at the *correction curve* indicated by this *marker*. Then clamp to the *fixed bar*. Proceed in like manner with the other *pointers* in succession, locking the system with the last outside *pointer* used. The range on the *movable scale* at the *index* under the *reading glass* is the corrected range. The range board operator transmits this corrected range to the gun emplacements.

*NOTE.*—In operating the range correction board, it is not necessary to return any pointer to the normal of its set of correction curves. It is necessary only to set the ruler and index at the range for the set-forward point, and move each pointer directly to its proper correction curve. The correction curve is frequently imaginary, and lies between two of the plotted curves, in which case the pointer is set on the imaginary curve, as indicated by the marker.

[*Inverse Problem: To find the velocity as a result of trial shots.*—Set the ruler for range to the center of impact of the splashes. Set the movable index to the range to the center of impact of the splashes on the fixed range scale. Set the movable range scale to the range to the center of impact of

the splashes. Set the velocity pointer to the velocity assumed for trial shots and clamp it to the movable bar. Then shift the movable range-scale until it reads the range to the fixed point assumed as target for the trial shots. The velocity pointer will now indicate the velocity corresponding to the center of impact of the splashes.]

*Test of accuracy.*—There are two tests for accuracy, viz:

For mechanical accuracy:

Use each set of *test points* marked on the correction curves and on the same range line and determine the corrected range. The true corrected range corresponding to each set is shown in brackets on the margin. Repeat several times for each set and record the difference of each determined range from the true range. The mean of these differences is the mechanical error. An officer should conduct this test, exercising the utmost care in operating the board.

For accuracy of the range board operator:

Direct method.—The range board operator uses the *test points* with the *index covered*.

Reverse method.—*After a series of corrected ranges have been determined by the range board operator, the range officer will set each pointer at the normal of its set of correction curves.*

The differences in ranges on the two scales under the index in excess of the mechanical error will be due to inaccurate work on the part of the range board operator.

Other methods of test may be devised if found desirable.

#### TIME-RANGE BOARD

##### Description

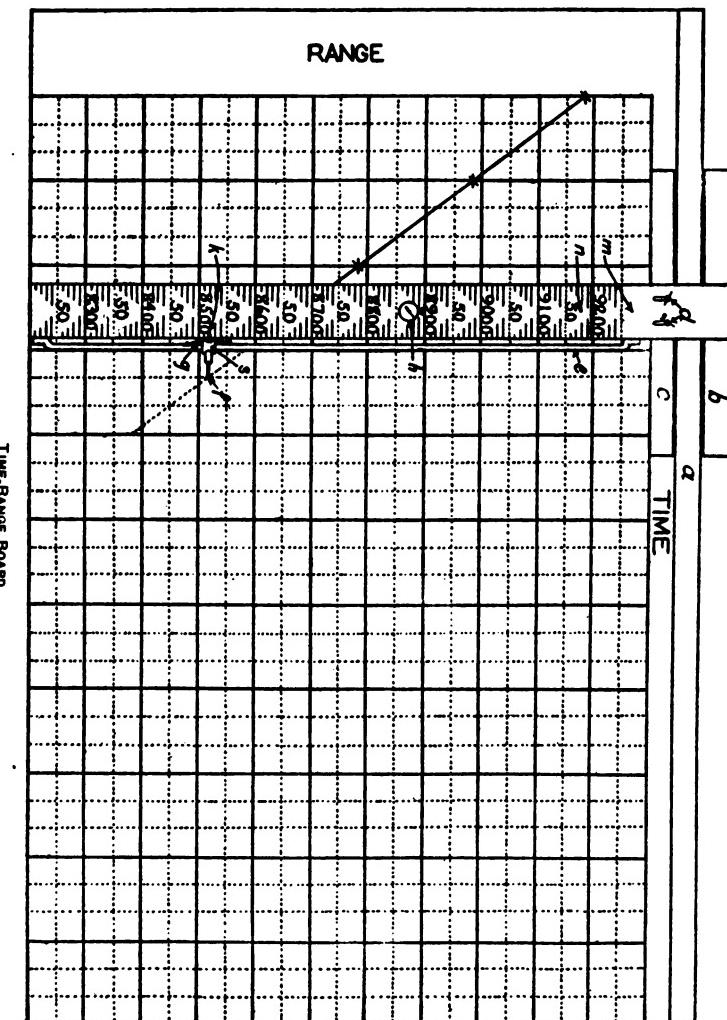
400. The time-range board consists of a blackboard approximately 9 feet by 6 feet in exterior dimensions, over which a T-square slides. It is ruled as shown in the accompanying diagram, the vertical lines representing time lines and the horizontal lines representing range lines. The distance between full range lines is 100 yards and the distance between full and broken range lines is 50 yards. The interval between full time lines is 30 seconds, and this interval is subdivided into 10-second intervals by dotted lines.

\* \* \* \* \*

A stop watch "h" (kept running with the time-interval bell) is hung at some convenient point on or near the T-square.

##### Operation

(a) Normal method with T-square.—When the first range is received by the range recorder (usually about 20 seconds after the instant of observation) he plots the range by a cross (X) in chalk on the first time line on the left of the board, opposite the proper point on the range scale. This marks the corrected range of the set-forward point for about ten seconds ahead. Similarly, the second range, when received, is plotted by a cross in chalk on the second time line. A full chalk line is drawn joining the two cross marks, and is prolonged by dots until the dotted line intersects the third time line. This plotting process continues as successive ranges are received by the range recorder until the last time line is reached, or until the plotted time-range line runs off the board, when the range is immediately transferred back to the first time line on the left and near the top or bottom of the board (making the necessary changes in thousandths and hundredth digits on the range scale), and the process is then continued as just described.



The successive plotting of ranges should form a regular curve, the ordinates of which give the corrected ranges of set-forward points for any time of firing. The rate of increase or decrease in range is shown by the curve in such a manner as to be easily noted. Any range error made by the range section is revealed by a sharp break in the regular time-range curve. When such sharp break appears, the range recorder indicates the location of the point on the board by a small circle instead of a cross, but rejects it as a point of the time-range curve and continues the regular curve in a dotted line until it is ascertained precisely whether the break was due to an error or to a sudden change in the course of the target.

In the case of guns mounted on disappearing carriages, when the range recorder hears the command "Trip" he notes the time on the stop watch to the nearest five-second mark, and sets the T-square so that the right edge of the leg is adjusted to the time noted. He then moves the slide so that the end of the pointer touches the time-range curve. The subpointer now indicates the corrected range of the set-forward point for the instant of firing, and the range setter uses this range for setting the gun range-scale.

After the T-square and subpointer are set they are not moved until after the command "Ready" has been given.

No range is set on the gun-range scale until the command "Trip." After the gun commander notes whether the gun goes fully into battery, he verifies the range setting. In case the range setting is wrong, he causes the range setter to correct it instantly and, if necessary, requires the range recorder to reset his T-square. After verifying the setting, the gun commander calls "Ready," and the gun pointer fires the gun, or, if friction primer has to be used, gives the command "Fire" as soon thereafter as the gun is pointed.

In case of guns mounted on barbette carriages, the operation is the same except that the T-square is set on a *selected starting time* instead of at the command "Trip," and the gun commander does not verify the range.

The range recorder stands in such position as will not interfere with the range setter's seeing the range indicated by the subpointer.

(b) Alternative method without T-square.—The following method of using the time-range board without the T-square is authorized:

The time-range curve is plotted as described in (a). In this case, the ranges are placed on the time-range board, instead of on the T-square.

At a selected starting time (for example, the command *TRIP*) the range-setter (or some other member of the gun section to be designated by the battery commander), takes from the time-range curve, the corrected range of the set-forward point which will be the correct range setting if the gun is fired a certain definite number of seconds after the starting time (for example, 15 seconds). This range is set on the gun range scale.

The gun commander notes whether the gun goes fully into battery, verifies the range setting, and calls "*READY*" in time for the gun to be fired at the time corresponding to the range setting.

In case of a delay so that the gun cannot be fired at the correct time, a new range for a definite number of seconds ahead is taken from the time-range curve.

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